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CATALOGUE

OF THE

FOSSIL FISHES

IN THE

BRITISH MUSEUM

(NATURAL HISTORY),

CROMWELL ROAD, S.W.

PART III.

CONTAINING THE

ACTINOPTERYGIAN TELEOSTOMI OF THE ORDERS CHONDROSTEI (CONCLUDED), PROTOSPONDYLI, AETHEOSPONDYLI, AND ISOSPONDYLI (IN PART).

BY

ARTHUR SMITH WOODWARD,
F.G.S., F.Z.S.

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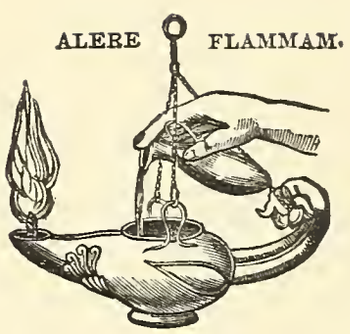

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PREFACE.

The first volume of the present Catalogue of Fossil Fishes—the result of several years' most patient and assiduous study—appeared in March 1889; the second followed in January 1891; now, after an interval of four years, the third instalment of Mr. Arthur Smith Woodward's carefully-executed work is satisfactorily completed.

The whole of the first volume, and a part of the second, are occupied with the description of the great series of remains of the Elasmobranch Fishes (Sharks, Rays, and Chimæras); followed in Volume II. by the Ostracodermi (that remarkable group of most ancient bony-plated fishes, represented by *Cephalaspis*, *Asterolepis*, *Pterichthys*, &c.), the Dipnoi, Crossopterygii, and, lastly, by the Palæoniscidæ and Platysomidæ.

The present volume carries us through the great series of Actinopterygian fishes of the Chondrostean type, and completes the Catalogue to the end of the Jurassic series, including also some of the later survivors of these older forms. Many of these Jurassic fishes seem to foreshadow, in various points of their structure, an approach to the more modern forms of Teleostean fishes by which they were presently to be succeeded.

This third volume will be found to contain much new and important information regarding the osteology and systematic position of the Pycnodonts. From specimens obtained from the

Leeds Collection, most interesting points have also been worked out in reference to the osteology of *Lepidotus* and *Caturus*.

The plates and illustrations throughout this work have been entirely prepared by Miss G. M. Woodward, and attention is specially called to the admirable restorations of *Lepidotus*, *Dapedius*, *Cleithrolepis*, *Eugnathus*, *Caturus*, *Aspidorhynchus*, and *Leptolepis* in the present volume, executed by that Artist under the Author's direction.

It is hoped that the next volume will complete the Catalogue of the Fossil Fishes in the Museum. It will be devoted entirely to that great series of later forms, commonly termed the "Teleostean Fishes."

HENRY WOODWARD.

British Museum (Natural History),
Geological Department,
November 15th, 1895.

INTRODUCTION.

During the Mesozoic Period the Actinopterygian fishes of the Chondrostean type were gradually replaced by others which advanced towards the modern Teleostean type. The latter finally became dominant in the seas of the epoch of the Chalk. In the course of this change in the character of the fish-fauna, the successive stages were represented by numerous minor modifications, which have little relation to the direct line of progress but present many features of great morphological interest. It is the object of the present volume to trace these phases of development in detail, and to record in as nearly a natural order as possible the variations of each at the time of its dominance.

Chondrostëi.

Firstly, however, there is the question of the fate of the Chondrostei themselves, which are represented even at the present day by a few survivors.

The origin of these fishes, as defined in the present Catalogue, is still entirely obscure. Among known fossils they range downwards as far as the Crossopterygians, while there is as yet no evidence of a link between these two groups. On the other hand, it is clear that the Chondrostean is later than the Crossopterygian type; for the former is represented in the Devonian solely by the rare genus *Cheirolepis*, while the latter is dominant throughout, and the members of the Chondrostei do not flourish vigorously until those of the Crossopterygii begin to decline in the Carboniferous and Permian. The modifications by which a Crossopterygian could be changed into a Chondrostean are also readily comprehensible. In the latter the paired fins are always polybasal, with excessively shortened lobe; and among Crossopterygii the genera with most

elongated lobate fins flourish the earliest, all survivors above the Devonian having the lobe comparatively abbreviate. The large pair of gular plates so characteristic of the Crossopterygii is always wanting in the Chondrostei; but the lateral gulars are merely further subdivided to become the ordinary paired series of branchiostegal rays, and in this connection it is noteworthy that both in *Cheirolepis* and many later Palæoniscidæ the subdivision is not complete anteriorly where a pair of very large plates persists. The ridge-scales on the upper caudal lobe of Chondrostei represent the superior rays of the caudal fin in Crossopterygii, as is indicated by the presence of the endoskeletal supports in *Chondrosteus* and the existing genera; while it is not unlikely that the fulcra are modified enamelled anterior fin-rays such as occur, for example, in *Osteolepis*.

When the Chondrostei suddenly become dominant, as they do in the Lower Carboniferous, they already exhibit a remarkable series of modifications, which are enumerated in Part II. of this Catalogue. The family of Palæoniscidæ is represented chiefly by fishes with regular rhombic scales and distally-bifurcating fin-rays; but there is one case in which the scales are cycloidal and deeply imbricating (*Cryphiolepis*), another in which the scales are absent except upon the caudal lobe (*Phanerosteon*), and a third in which the fin-rays never branch (*Holurus*). Some, moreover, have a large mouth with powerful conical teeth; others, a small mouth with comparatively insignificant teeth. There is also a good deal of variety among the Platysomidæ, which are deep-bodied fishes closely related to the Palæoniscidæ.

As these fishes are traced upwards, they exhibit very little essential change. The upper caudal lobe never appears to atrophy in the least; the supports of the dorsal and anal fins never equal in number the appended dermal rays; the infraclavicular plates always remain; the ribs, if present, never ossify. The Platysomidæ, indeed, become extinct in the Upper Permian, where, in addition to the normal genus *Platysomus*, there is a scaleless fish (*Dorypterus*) which seems to represent them. The large-mouthed and small-mouthed, rhombic-scaled and round-scaled, perhaps also the scaleless, Palæoniscidæ range as far upwards as the Permian; and then the family presents less variety in its representatives. All the Mesozoic genera are predaceous fishes with a large mouth and deeply overlapping scales which are usually very thin; and the genus *Coccolepis*, which is the only known Palæoniscid ranging above the Lias,

has practically cycloidal scales without peg-and-socket articulation. Moreover, while the endoskeletal supports of the dorsal and anal fins are in two series in such Palæozoic genera as *Elonichthys* and *Pygopterus*, they are distinctly shown to be confined to one series in the Mesozoic *Coccolepis*.

The last term of the Palæoniscid series (*Coccolepis*) thus approaches a higher grade than that of the Chondrostei in the character of its dorsal and anal fins. In every other respect, however, it is typically and essentially Chondrostean; the baseosts of its pelvic fins are relatively as large and numerous as those of a modern sturgeon. It is noteworthy that the only known approximation to a higher grade occurs among much more generalized fishes, those of the Triassic family of Catopteridæ.

The little that is known of *Catopterus* and *Dictyopyge*, the two genera of Catopteridæ, forms the subject of the opening pages of the present volume. Much of this information is unsatisfactory and needs verification; but it may be asserted, with considerable probability of correctness, that these fishes possess a Palæoniscid head and shoulder-girdle, while the tail is only hemi-heterocercal, and the single series of supports in the dorsal and anal fins almost equals in number the apposed dermal rays. Such being the case, here is an interesting illustration of the common law, that the links between a lower and a higher group are not to be sought among the specialized types of the former but among those with the most generalized secondary characters.

Palæontology seems to demonstrate that the various modifications in the minor characters of the Palæoniscid fishes eventually led to the development of a series of types which can only be described as extremely degenerate, namely the modern sturgeons (Acipenseridæ) and paddle-fishes (Polyodontidæ).

There is much probability, indeed, that other degenerate series originated from Chondrosteans related to them; and it is interesting in this connection to notice the case of the Belonorhynchidæ (catalogued on pp. 9–23). These are eel-shaped fishes with a long pointed head, an abbreviate-diphycercal tail, short dorsal and anal fins, and small paired fins. The trunk is nearly always, if not always, destitute of ordinary scales; but it is armoured with four distinct longitudinal series of imbricating scutes—one median dorsal, one median ventral, and a pair supporting the "lateral line." The dorsal and anal fin-supports are much fewer than their apposed rays, though apparently only in a single series; and the

whole of the branchiostegal apparatus is wanting, while the opercular series is reduced to a single small operculum. If these are not degenerate Chondrosteans they must be abnormally modified Crossopterygians, as suggested by O. M. Reis [1].

Degeneracy of the Palæoniscid type in the direction of the modern sturgeons is distinctly observed in the Chondrosteidæ of the English Lower Lias. *Chondrosteus* resembles the Palæoniscidæ in the arrangement of its cranial roof and the opercular apparatus, except that the gular plate and possibly a few of the branchiostegal rays have disappeared; its trunk is like that of the abnormal Palæoniscid *Phanerosteon*, and equally similar to that of the modern *Polyodon*; its reduced toothless jaws are much simpler than those of the Palæoniscidæ, and the premaxillæ have disappeared as in all the modern sturgeons and paddle-fishes. A more clearly intermediate type can scarcely be conceived; and the fact that the Polyodontidæ at least once possessed a regular squamation is demonstrated by the Eocene genus *Crossopholis*.

Protospondyli.

It has already been remarked that the Catopteridæ of the Trias incline towards a higher type of fish than the Chondrostei, to which they technically belong; but the two known genera cannot be the ancestors of this more advanced race, for at least one of its representatives (*Acentrophorus*) has already been found in the Upper Permian, while numerous and varied forms are commonly met with in the Trias and Rhætic. It can only be affirmed that as soon as six important modifications had simultaneously affected the Chondrostean skeleton, another vigorous race arose and a new impetus seems to have been given to variation. These changes comprised (i.) the almost complete atrophy of the upper caudal lobe, (ii.) the reduction of the dorsal and anal fin-rays to exactly the same number as their supports, (iii.) the disappearance of the infraclavicular plates, (iv.) the loss of the pelvic baseosts, (v.) the subdivision of the hinder expansion of the maxilla, and (vi.) the withdrawal of the preoperculum from its extension over the cheek. Numerous types, in some respects parallel to those already noticed among the Chondrostei, are to be recognized in this later race; and the only difficulty is that, owing to the imperfection of the geological record, very few of these types are revealed until approaching

[1] O. M. Reis, "Zur Osteologie und Systematik der Belonorhynchiden und Tetragonolepiden," Geogn. Jahresh. 1891 (1892), p. 157.

full development. It is true that there are links between most of the families, rendering precise definitions almost impossible; and evidences of evolution can be detected in a slight degree as the different groups are traced upwards in their range. All the families, however, except the modern Lepidosteidæ and Amiidæ, had already become differentiated before the period of the Lower Oolites.

Semionotidæ.

Robust Protospondyli with a small mouth and grinding teeth, and predaceous forms with a large mouth and conical teeth, appear abundantly in the Trias; but as the former do not seem to pass into modern bony fishes, while the latter can be distinctly traced towards the characteristic types of Upper Cretaceous and Tertiary times, those with a small mouth and more or less tritoral dentition are treated first.

This arrangement seems all the more natural since the family of Semionotidæ—the most generalized of the series—is first represented by *Acentrophorus* in the Upper Permian. No other representative of the Protospondyli has hitherto been discovered in Palæozoic formations, and it is interesting to notice that this unique fish is the most generalized genus of the family to which it belongs. Before the end of the Triassic period, however, all the principal types of Semionotidæ had appeared; and the most specialized genus *Tetragonolepis* occurs in the Upper Lias.

The Triassic genera most closely related to *Acentrophorus*, namely, *Semionotus* and *Pristisomus*, scarcely differ from it except in possessing well-developed ridge-scales. The former is confined to the Trias in North America, and is not known to range above the Rhætic in Europe. There is, however, an interesting allied genus, *Aphnelepis*, in the supposed Jurassic of New South Wales; and this exhibits comparatively thin scales, which suddenly become extremely delicate on the caudal region behind a line connecting the points of origin of the dorsal and anal fins.

The Triassic genus *Colobodus* scarcely differs from *Semionotus* except in its powerful grinding dentition and the reduction of its fin-fulcra to a fine and close series. In many respects it resembles *Lepidotus*: but the tooth-pavement does not appear to exhibit any regular arrangement, and the scale-articulation is not strengthened by the development of spurs from the overlapped margin such as characterize even the earliest species of *Lepidotus*.

Lepidotus itself, exhibiting all its typical characters, has also been lately discovered in the Upper Trias or Rhætic (*Prolepidotus gallineki* of Michael). Moreover, it is clear that this genus cannot be a specialized form of *Colobodus*; for all the early species to the summit of the Lias exhibit the inner teeth of moderate size on comparatively long pedicles, and the powerful tritoral arrangement is not observed before the Upper Jurassic. Some of the Wealden species are distinguished by the possession of ring-vertebræ; but all still retain the thick scales, large biserial fin-fulcra, and complete opercular apparatus. The comparatively regular arrangement of this slowly-acquired tritoral dentition is striking, when compared with the early approach to a similar type in the Triassic *Colobodus*.

The deep-bodied fishes which begin with *Dapedius* in the Upper Trias are noteworthy for the rapid changes exhibited in their form and squamation. *Cleithrolepis* from South Africa and Australia, and *Tetragonolepis* from the European Upper Lias and the Indian Kota Formation, have an excessively deepened trunk, with scales strengthened by an unusually thickened anterior margin; and the latter genus is characterized by very thin scales on the hinder part of the caudal region. Still more interesting is the newly-established genus *Aetheolepis*, from the Upper Hawkesbury-Wianamatta Series of New South Wales, which has the ordinary deepened rhombic scales, united by peg-and-socket, on the abdominal region, while these gradually lose their articulation, become cycloidal and deeply overlapping as they pass backwards towards the pedicle of the tail.

Among Semionotidæ, therefore, a precocious though irregular development of grinding-teeth is observed in a genus of the Trias (*Colobodus*); deep-bodied fishes with styliform rather than tritoral teeth, lose their caudal scales in the Upper Lias (*Tetragonolepis*); and a more normal series (*Lepidotus*), abundantly represented throughout the Jurassic period, retains most of its primitive outward features, while the dentition forms a nearly regular tritoral pavement, ring-vertebræ are acquired, and the cheek-plates and supratemporals are irregularly subdivided in the latest Wealden forms.

Macrosemiidæ.

Another series of Protospondyli, with small mouth and styliform rather than conical teeth, also appears first in the Trias, and is represented throughout the Jurassic period by numerous long-bodied fishes with extended dorsal fin, while at least one genus survives even in the Upper Cretaceous.

Here, again, the earliest term in the series (*Ophiopsis*) is the most generalized; and it has the most extensive range (Upper Trias—Purbeckian). It is, indeed, a distinct link between the family of Macrosemiidæ (to which this Catalogue assigns it) and that of the Eugnathidæ to be considered below. The Lower Kimmeridgian and Purbeckian species are also interesting as exhibiting ring-vertebræ, the separate, alternating pleurocentral and hypocentral rings being sometimes observable in part of the caudal region.

The diminutive Rhætic *Legnonotus*, with greatly extended dorsal fin, is a more pronounced member of the Macrosemiidæ. This has an apparently regular squamation; but the closely-related genus *Macrosemius* (Lower Kimmeridgian, Portlandian, and Purbeckian) is remarkable for the degeneration of its scales, which are very thin and subdivide towards the dorsal and ventral margins, being usually wanting near the former. The dwarfed species of Portlandian and Purbeckian age may perhaps have been entirely scaleless. There are no fulcra except on the caudal fin; but the rays of the dorsal fin in some species are curiously denticulated on the hinder border. Traces of vertebral centra are never observable.

Histionotus is a thick-scaled contemporary of *Macrosemius*, with fulcra on all the fins and with delicate ring-vertebræ. *Propterus* and *Notagogus*, of the same age, are characterized by the subdivision of the dorsal fin into two parts; and the former has thinner scales and more delicate vertebræ than the latter.

The late Cretaceous genus *Petalopteryx* is an excessively elongated fish with irregularly arranged rhombic scales, and the robust cheek-plates subdivided into small tesseræ.

The two most characteristic features of the Macrosemiidæ—the elongated trunk and excessively extended dorsal fin—are thus developed early in a Rhætic fish with normal squamation (*Legnonotus*); ring-vertebræ are only well-formed in the genera which retain comparatively thick scales; the scales and fulcra begin to degenerate in the Upper Jurassic (*Macrosemius*); the scales, though still rhombic, are irregularly subdivided in the Cretaceous *Petalopteryx*, and in this unique genus the cheek-plates are represented by an investment of small tesseræ.

Pycnodontidæ.

A curious parallelism will be noticed in the development of the Semionotidæ and Macrosemiidæ as thus briefly sketched. Vertebral

centra are never fully formed, and they only reach even the annular stage when, notwithstanding specialization, the fish retains its original thick and continuous squamation. The cheek-plates are apparently never lost, but become irregularly subdivided in the later forms; and there is always a tendency to reduction of the branchiostegal apparatus. The scales often degenerate or disappear in certain parts—on the back in *Macrosemius*, on the tail in *Aphnelepis*, *Aetheolepis*, and *Tetragonolepis*. Fulcra are least conspicuous in the genera which exhibit most tendency to such degeneration of the scales.

These considerations are important because, if truly expressions of fact, they seem to determine the systematic position and affinities of the anomalous family of Pycnodontidæ. As amply demonstrated in the Catalogue, these fishes exhibit an appendicular skeleton quite distinct from that of the Chondrostei, but identical with that of the Protospondyli and Aetheospondyli, and only distinguished from that of the Isospondyli by the large number of basals in the pectoral fin. The additional characters of the axial skeleton of the trunk and the mandible place them unhesitatingly among the Protospondyli.

In five respects they are merely extreme members of the modified series of deep-bodied Protospondyli, which begins with *Dapedius*. There is never any approach to the development of vertebral centra; and even when the axis acquires special rigidity (e.g. *Palæobalistum* and *Pycnodus*) this is attained by the interlocking of laminar expansions of the neural and hæmal arches. The cheek-plates, so far as known, are reduced to tesseræ. The branchiostegal rays are not more than two in number. The fin-fulcra are still more insignificant than in *Tetragonolepis*. The caudal region is very commonly destitute, or nearly destitute, of scales behind a line connecting the origin of the dorsal with that of the anal fin.

When examined more closely, it is not difficult to perceive that even the apparently unique characters of the Pycnodonts are also the ultimate result of tendencies to specialization already exhibited by the Semionotidæ.

Firstly, there is the forwardly-displaced mouth with crushing-teeth, which is much like that of the latest species of *Lepidotus*, only a little more advanced and powerful, and thus more firmly fixed to the skull. The mode of fixation, however, resembles that observed in fishes so remotely related to each other as *Gymnarchus*, *Tetrodon*, and *Mormyrus*: proving that it is merely a physiological

necessity, and not a character of taxonomic importance. The absence of a maxillary dentition is not remarkable, considering its feebleness in the species of *Lepidotus* with most specialized grinding-teeth.

Secondly, there is the question of the mode of growth of the dentition. There may sometimes be vertical successional teeth, but the present writer has never observed satisfactory evidence of them; even if occurring, they must thus be extremely unusual. The contrast with *Lepidotus* is indeed very marked; but the loss of successional teeth in the higher Vertebrata (*e. g.* in elephants and kangaroos) is a sign of great specialization, and it is not improbably the same among these fishes. So far as the dentition is concerned, *Lepidotus* need not be more widely separated from *Mesodon* than is the extinct *Dinotherium* from the modern elephant.

Thirdly, the enormous development of the preoperculum and the concomitant reduction of the operculum are again paralleled in distantly-related fishes, which possess similarly powerful, short jaws in a very forward position. The existing genera *Tetrodon* and *Lampris* may be cited as illustrations. Once more it is thus evident that we are concerned with a physiological correlation of no fundamental significance, and one which is the mere outcome of specializations towards which there is already a tendency in the Semionotidæ.

Finally, the anomalous character of the cranial roof is at first more difficult to understand. It will, however, be observed that there is a most striking resemblance between this roof as known in *Mesturus* (p. 192, fig. 30) and that of the modern sturgeon (*Acipenser*). Moreover, the disposition of the sutures is evidently as capricious as that in *Acipenser*; for not only do the parietal plates lack bilateral symmetry in the specimen figured, but there is also considerable difference in the arrangement of the median plates in a second specimen in the Leeds Collection, which is otherwise very similar. Now, it has already been shown (p. viii) that *Acipenser* is merely the surviving terminal form of a long series of Chondrostean fishes, which in the Liassic period still retained a normal cranial roof. Such having been demonstrated among Chondrostei, it would not be surprising to find a similar case of development or degeneracy among Protospondyli. In the present state of knowledge it appears likely that this parallel case is to be recognized among the Pycnodonts.

The result of these considerations is, therefore, that the Pycno-

dontidæ bear much the same relation to the Permian *Acentrophorus* as the modern sturgeons to the Palæozoic Palæoniscidæ; the latter having only advanced a stage further in the matter of teeth, which are in them not only destitute of successors, but are also lost before the fish becomes adult. Among Pycnodontidæ as a race, tooth-specialization consists in the reduction of the tritors into a few regular longitudinal series, and there is only one known genus (the Cretaceous *Anomœodus*) in which there is much tendency towards the loss of this armature.

The facts detailed in the Catalogue, as just briefly analysed, seem to render it unnecessary to discuss the still widely prevalent belief that the Pycnodonts are the direct successors of the Platysomidæ. The elaborate researches and careful reasoning of Traquair sixteen years ago,[1] ought to have sufficed ere this to banish the theory even from popular handbooks; nevertheless, it survives in a shape scarcely different from that current at the time when comparatively nothing was known of the Platysomid skeleton. It must suffice to repeat, that the Platysomidæ never make the faintest approach to the Pycnodontidæ in a single essential character. The trunk and fins are as thoroughly Chondrostean in the most specialized as in the most generalized type; the cranial osteology and arrangement of the jaws are fundamentally different even when the dentition is most powerful.

If speculation were permitted in seeking for the direct ancestors of the Pycnodonts, it might be most profitable to turn towards the earliest Mesozoic fishes of the *Colobodus*-type. The appearance of the family, however, still remains as mysterious as that of the Cœlacanthidæ among the Crossopterygians; and the long-continued permanence of so remarkably specialized a type (Lower Lias—Eocene) is curiously paralleled in the range of the more primitive family just mentioned (Lower Carboniferous—Chalk). Persistent types of this character are rarely met with.

Eugnathidæ.

It has already been mentioned that the small-mouthed Protospondyli considered above appear to have left no descendants. At least, no definite links can be recognized between these and modern fishes. The large-mouthed Protospondyli with conical teeth, on the other hand, can be traced from the Trias upwards

[1] R. H. Traquair, "On the Structure and Affinities of the Platysomidæ," Trans. Roy. Soc. Edinb. vol. xxix. pp. 343–391, pls. iii.–vi. (1879).

until they pass almost imperceptibly into the typical physostomous bony fishes; and these forms may be arranged in at least three families.

This classification, adopted in the Catalogue, is a little different from any hitherto proposed, because no great systematic value is ascribed to the characters of the scales. When one genus of Mesozoic ganoid (*Aetheolepis*) is proved to exhibit every variety, from the thick, rhombic, firmly articulated scales of the abdominal region to the delicate, cycloidal, deeply-overlapping scales of the caudal pedicle—when, moreover, thick and thin scales cover respectively the abdominal and caudal regions of *Tetragonolepis*, it is no longer possible to depend entirely upon scale-characters for the definition of families and orders. Since, therefore, *Eugnathus* and *Caturus* are identical in their osteology, the latter merely differing from the former in the subdivision of its supraorbital plates and the tenuity of its overlapping scales, these two genera are now placed in one and the same family. They and their allies constitute the Eugnathidæ, which range from the Upper Trias to the Upper Cretaceous; and it is difficult to distinguish the more specialized forms from the Amiidæ.

Both *Eugnathus* and *Caturus* range from the Upper Trias to the Kimmeridgian, and the latter probably even to the Wealden. The deeper-bodied *Heterolepidotus*, which is scarcely distinguishable from *Eugnathus*, also seems to exhibit as wide a range as the latter. More specialized genera, however, like the highly ornate *Ptycholepis* (Upper Trias—Upper Lias), the delicate, overgrown *Osteorachis* (Lower Lias), and the cycloidal-scaled *Eurycormus* (Oxfordian and Kimmeridgian), are very restricted in their range; so also are the Cretaceous genera *Neorhombolepis*, *Otomitla*, and *Lophiostomus*.

Neorhombolepis and *Otomitla* are particularly interesting because, so far as known, they retain the external characters of *Eugnathus*, and at the same time possess vertebral centra as completely developed as those of *Amia*. If correctly placed in the Eugnathidæ, they form another illustration of the principle noted among the Semionotidæ and Macrosemiidæ, that the most advanced stage of the endoskeleton is attained in the latest members of the race with the least modified exoskeleton. *Lophiostomus*, which is characterized by the fusion of most of its cranial roof-bones, and is provided with a pair of bosses on the hinder portion of this roof, seems to exhibit only ring-vertebræ.

Amiidæ.

The separation of the Amiidæ from the Eugnathidæ is perhaps arbitrary, but it is at least convenient. The genus *Eurycormus*, with cycloidal scales and ring-vertebræ, may be as appropriately placed in one family as in the other; so also may the small notochordal fishes named *Liodesmus*. The former, however, is assigned to the Eugnathidæ because it exhibits fulcra on the fins; the latter to the Amiidæ, because all its fins seem to be destitute of fulcra.

Amia itself does not date back beyond the Upper Eocene, but the extinct species and possibly allied genera are very unsatisfactorily known, owing to the fragmentary nature of the fossils. Nevertheless, the vertebral centra are so characteristic that it is possible to obtain considerable information as to its former range; and the interesting result is arrived at, that *Amia* (or fishes represented by fragments indistinguishable from it) was distributed throughout Western Europe in the Eocene period, and survived in some areas so late as the Lower Miocene. The supposed Amioid from the Miocene of Oeningen, Switzerland, proves to have been wrongly determined, and is a truly "Teleostean" fish.

Pachycormidæ.

A remarkable modification of the thin-scaled type of Eugnathidæ suddenly appears in the Upper Lias. The segments of the axial skeleton of the trunk multiply considerably; the rostrum begins to project and prevents the premaxillæ from meeting in the middle line; while the fins, especially the pectorals and caudal, are adapted for rapid progression. This modification, in fact, eventually results in genera having the outward form of the modern "sword-fishes"; and they are particularly interesting as showing how the Protospondylic type of axial skeleton may be modified to produce the same mechanical effect as a robust chain of vertebræ terminated behind by its complex hypural bone. All these fishes are proved to have had a persistent notochord, and it is not improbably to compensate for this weakness that the segments of the axial skeleton are so remakably shortened and multiplied. In most genera also a single, much-expanded hæmal arch has been observed at the base of the lower lobe of the powerful, deeply-forked tail; this admirably serving the purpose of a hypural, and yet not fundamentally altering the normal "stegurous" tail such as characterizes all Protospondyli.

Sauropsis, apparently ranging from the Upper Lias to the Lower Kimmeridgian, and *Euthynotus*, confined to the Upper Lias, are the least specialized genera of Pachycormidæ. *Pachycormus* itself is known only from the Upper Lias, and is a little more modified, having lost the pelvic fins. *Hypsocormus*, from the Oxfordian and Kimmeridgian, exhibits more powerful teeth than any of the earlier genera, these fixed to the base of sockets which are incomplete on the inner side; and there is one species, *H. leedsi*, possessing a slightly more prominent rostrum than any earlier fish. The latest genus *Protosphyræna*, known only by comparatively fragmentary specimens from the Cretaceous both of Europe and America, nearly always exhibits a much more produced rostrum, while its large teeth are fixed in complete sockets; and the pectoral fins of this fish are still narrower and more elongated than those of its forerunners in the Jurassic period.

If the interpretation of the Pachycormidæ suggested in this Catalogue prove correct, there is thus most distinct evidence of gradual progression as they are traced upwards in their range.

Aetheospondyli.

The recognition of this group is a confession of ignorance. As to the origin and immediate relationships of the Aspidorhynchidæ and Lepidosteidæ, there is still not the faintest clue. That these two families are close allies is generally admitted; that they are connected in some way with the Protospondyli as above defined, is also a common belief. They are peculiar, however, in exhibiting annular or solid centra throughout the length of the vertebral column, no alternating pleurocentra and hypocentra even in the caudal region; and they cannot be referred to the Isospondyli on account of the complexity of the mandible. They may thus be provisionally assigned to an intermediate, though scarcely annectant group, which is named Aetheospondyli in allusion to the unique variations of the vertebral centra from the biconcave or amphicœlous to an opisthocœlous type.

Aspidorhynchidæ.

The Aspidorhynchidæ are long-bodied fishes with deep ganoid flank-scales, small fins, and elongated snout, ranging from the Bathonian to the Upper Cretaceous inclusive. They are remarkable for the possession of a median presymphysial bone in the mandible.

Aspidorhynchus, with prominent rostrum, exhibits only one series of small teeth on the splenial bone, and has ring-vertebræ. It seems to be confined to the Jurassic; but a second genus, *Belonostomus*, ranges from the Upper Jurassic to the Upper Cretaceous inclusive, and in the course of this range the delicate ring-vertebræ gradually pass into centra which are pierced only by a very delicate thread of notochord. It is also noteworthy that the enlarged splenial, covered with tubercular teeth, excludes the dentary from the margin of the mandible in the English Chalk species, *Belonostomus cinctus*. Otherwise there is no special evidence of evolution in the family.

It is just possible that the small Triassic fish *Pholidopleurus*, doubtfully assigned to the Pholidophoridæ in the Catalogue (p. 479), may be a forerunner of the Aspidorhynchidæ; but its cranial osteology is as yet too imperfectly known for comparison.

Lepidosteidæ.

Nearly all the known fossil remains of Lepidosteidæ are mere fragments, none dating back further than the Lower Eocene. The only interesting fact to be deduced from these remains is, that fishes with scales and vertebræ identical with those of the existing American *Lepidosteus* inhabited Western Europe during the period of deposition of the Eocene and Lower Miocene deposits. Their range in the Old World thus corresponds with that of the fossil *Amia* already described. It is, of course, likely that their Mesozoic ancestors would not be recognized at first sight on account of the normal character of their vertebral centra; but the markedly forward inclination of the mandibular suspensorium seems to exclude comparison with all large-mouthed, conical-toothed Mesozoic ganoids except the Aspidorhynchidæ, and these cannot be their direct progenitors for many obvious reasons. The irregular subdivision of the facial bones has been shown to occur commonly among highly-specialized ganoids, though *Lepidosteus* still remains unique in having this segmentation extended to the maxilla. As to the well-known remarkable features in the soft parts of the existing fish, it is unfortunate that Palæontology cannot afford any definite information. Only one point may be mentioned, namely, that so far as can be judged from the cranium, the course of the olfactory nerves in *Dapedius* differs from the course of these nerves in the closely-allied genus *Lepidotus*, exactly in the same way that

the corresponding feature in *Lepidosteus* differs from that in all other surviving ganoids (*cf.* Proc. Zool. Soc. 1893, p. 565).

Isospondyli.

It is interesting to note that all the higher fishes, like the highest of the terrestrial Vertebrata, are characterized by a comparatively simple mandible. Only doubtful or extremely rare exceptions are recorded [1] to the rule, that each mandibular ramus in these types consists of two or three elements, an articulo-angular (or articular and angular) behind, a dentary in front. The circumstance is all the more remarkable because, on acquiring this simplification of the jaw, the Teleostomes seem to be infused with new vigour: vertebral centra invariably occur, at first as simple rings, then as robust amphicœlous bodies; and a still more varied series of families arises, including analogues of all the principal modifications observed among the lower races, these being superinduced upon the new and advanced type of skeletal frame.

The first and least specialized suborder of these higher fishes is that of the Isospondyli, thus named by Prof. E. D. Cope in allusion to the fact that the vertebræ are simple, not fused into a group behind the head or related in any way to arrangements for an osseous connection between the air-bladder and the organs of hearing. It comprises a large number of families, mostly Tertiary and Recent, and only the few Jurassic representatives of the suborder with some of those of Cretaceous age are treated in the present Part of the Catalogue.

Pholidophoridæ.

The earliest clearly-proved instance of the simple mandible just referred to, is that afforded by the small fishes of the genus *Leptolepis* occurring in the European Upper Lias. As already observed by Agassiz, however, the genus *Pholidophorus* exhibits a very close resemblance to *Leptolepis* in general aspect, the osteology of the head being remarkably similar, vertebral rings being tolerably well ossified, the fin-fulcra very small and usually lost, while the scales are often extremely thin and deeply overlapping though for the most part united by a peg-and-socket articulation; and it is noteworthy that no indications of splenial and coronoid elements have

[1] E. g., *Arapaima*, according to Owen, 'Anatomy of Vertebrates,' vol. i. p. 123, fig. 88 (1866).

hitherto been discovered in the jaw. It is thus very probable that the Pholidophoridæ are the earliest known family of Isospondyli; and if more conclusive specimens eventually confirm this inference, the suborder is proved to date back at least to the Upper Trias. In any case it is remarkable that *Leptolepis* and its immediate allies were a comparatively insignificant race until the Cretaceous period, when the Isospondyli and higher suborders became dominant; and they form an interesting example of the long persistence of a newly-acquired character before its possession becomes a factor of real importance in favouring the supremacy of the type.

The Pholidophoridæ, as defined in the Catalogue, are the only fishes with articulated rhombic scales which can be reasonably claimed as Isospondyli; and even the peg-and-socket articulation is inconstant if the genus *Archæomæne* (p. 488) is correctly associated with them. The most generalized member of the family, *Pholidophorus* itself, ranges practically unchanged from the Upper Trias, throughout the Jurassic, as far as the Purbeckian. An apparently allied genus (*Thoracopterus*), with excessively enlarged pectoral fins, is restricted to the Upper Trias. The Triassic *Pholidopleurus*, as already mentioned, is very doubtfully placed here; but two other genera with much-deepened flank-scales, namely, *Peltopleurus* of the Upper Trias, and *Pleuropholis* of the Upper Jurassic and Purbeckian, may be ascribed to the Pholidophoridæ with less hesitation; and there is possibly an almost scaleless representative of the family (*Ceramurus*) in the Purbeckian. One unique feature is also worthy of special note in *Pleuropholis*, namely, that the canal of the "lateral line" is deflected immediately behind the pectoral arch and extends not along the deepest flank-scales but along the adjoining series below.

Oligopleuridæ.

The few Upper Jurassic and Cretaceous fishes included in this family bear much superficial resemblance to the Amiidæ. All of them, however, exhibit completely ossified vertebral centra, never any alternating pleurocentral and hypocentral discs even in the caudal region; while the mandible appears to be destitute of splenial and coronoid elements, and thus confirms the suspicion suggested by the first character, that these fishes must be referred to a higher suborder than that of the Protospondyli. The fins, like those of the Pholidophoridæ, are fringed with fulcra; and it seems most reasonable in the present state of knowledge to place the

C. T. Regan, Proc. Zool. Soc. 1923, p. 455.

Oligopleuridæ with the latter family at the base of the Isospondylic series.

Leptolepidæ.

The Leptolepidæ differ from the two preceding families in the absence of fulcra on the fins, and are remarkable as being the earliest family in which intermuscular bones occur. These elements, forming so conspicuous a feature among modern fishes, appear to be arranged here only in a single series above the vertebral column in the abdominal region; though there may perhaps be traces of them sometimes also in the lower half of the caudal region. The vertebral centra in *Leptolepis* itself exhibit interesting gradations in the degree of development according to the geological age of the species; these centra never being more than delicate constricted rings or cylinders in the Upper Lias, and always strengthened by secondary peripheral calcifications in the Oxfordian and upwards. In *Thrissops*, which ranges as far at least as the Lower Cretaceous, the vertebral centra are still more robust.

These fishes, it will be noticed, approach very closely the Clupeidæ, among which they are sometimes included; but they are distinguished by the meeting of the parietal bones in the median line, by the non-fusion of the hæmal spines at the base of the tail, and by the presence of a thin film of ganoine on the scales.

The interpretation of the relationships of the Mesozoic Actinopterygian fishes thus briefly summarized, differs so much from any hitherto proposed that it has not been found possible to arrange a synonymy under the subordinal and family-headings in the Catalogue. Family-names not derived from generic names have also been ignored. The existing *Acipenser*, *Polyodon*, *Spatularia*, *Lepidosteus*, and *Amia* are now shown to afford a very inadequate and misleading idea of the actinopterygian ganoids, on account of their remarkably specialized nature. The characters of the appendicular skeleton are observed to be much more important than those even of the axial skeleton of the trunk, while the form and absence or presence of the scales, as also the degree of development of the branchiostegal apparatus, are features comparatively insignificant. It is thus no longer scientific to regard the "Acipenseroidei" as typical members of the group to which they belong; they are mere

degenerate survivors. It is equally impossible to justify the conception of the groups "Lepidosteoidei" and "Amioidei," most of the extinct fishes which are still commonly ascribed to the former being proved in the Catalogue to be much more closely related to the latter.

This result is merely the logical outcome of the new departure in Ichthyology made by Traquair in 1876,[1] when he published his classic memoir on the systematic position of the Palæoniscidæ. The characters which Traquair's researches have proved to be secondary in the group to which these typically Palæozoic fishes belong, are similarly shown to be of comparatively small taxonomic value in the higher groups of Mesozoic age to which the present volume specially refers. It therefore seems unnecessary to recapitulate and discuss the various classifications which have been proposed; for nearly all of them, even those published during the last fifteen years, fail to distinguish between the fundamental and the secondary features, which the memoirs cited have made quite clear.

It only remains to add that, in a work of this kind, a more or less definite judgment must sometimes be pronounced in cases where the known facts scarcely suffice for more than premature speculation; and it is always difficult to express a tentative result in terms which cannot be exaggerated in quotation. The present volume, like its predecessors, is therefore to be accepted merely as a convenient basis for further research, full of imperfections which each specialist will readily discover for himself. A few partly novel conceptions have been introduced, to direct attention to certain problems which seem hitherto to have been inadequately considered. A careful examination of nearly all the available specimens has enabled the writer to attempt a more detailed account of the osteology of the principal genera than has previously been published. For continued generous co-operation, thanks are not only due to the many scientific colleagues at home and abroad, to whom indebtedness has already been expressed in the previous volumes; they are likewise gratefully tendered to the Government

[1] R. H. Traquair, 'The Ganoid Fishes of the British Carboniferous Formations,' Part I. (Mon. Palæont. Soc., 1876). See also Memoir on Platysomidæ already quoted, and "Report on Fossil Fishes collected by the Geological Survey of Scotland in Eskdale and Liddesdale," Trans. Roy. Soc. Edinb. vol. xxx. pp. 15–71, pls. i.–vi. (1881), and "Notes on *Chondrosteus acipenseroides*, Agassiz," Geol. Mag. [3] vol. iv. pp. 248–257, figs. 1–5 (1887).

Geologist of New South Wales (the late Mr. C. S. Wilkinson, and now Mr. E. F. Pittman), the Rev. H. H. Winwood (Bath), the Rev. P. B. Brodie (Warwick), Edward Crane, Esq. (Brighton), and the Curators of the Museums of York, Whitby, Scarborough, Malton, Leicester, and Worcester, for facilities in studying the important collections under their charge. The unique collections of Mesozoic fishes in the Universities of Munich and Naples must be particularly mentioned as having afforded very special aid, thanks to the kindness of Professor K. A. von Zittel and of Professor F. Bassani.

ARTHUR SMITH WOODWARD.

Department of Geology,
November 15th, 1895.

List of Collections.

In addition to the Collections enumerated in Part I. (p. xxix) and in Part II. (p. xxiii), the following are also referred to in the present volume:—

Beckles Collection.—A large collection comprising fossil fishes especially from the Wealden of Sussex, purchased from the executors of the late Mr. S. H. Beckles, F.R.S., of St. Leonard's, 1891.

John Brown Collection.—Numerous Pleistocene Vertebrata and other fossils chiefly from Essex and Suffolk, collected by the late Mr. John Brown, of Stanway, and bequeathed by him to the late Sir Richard Owen, K.C.B., who presented them to the Museum in 1859.

Croizet Collection.—Specimens from the Tertiaries, chiefly Miocene, of Auvergne, France, purchased from the Abbé Croizet in 1848 and 1849.

Damon Collection.—The private cabinet of the late Mr. Robert Damon, of Weymouth, comprising fossils from the neighbourhood of Weymouth, purchased from his executors, 1890.

Jesson Collection.—A series of fossils from the Cambridge Greensand, Cambridge, collected by Mr. Thomas Jesson, of Northampton, and obtained by purchase, 1894.

Leeds Collection.—A large collection of Vertebrata from the Oxford Clay in the neighbourhood of Peterborough, made by Messrs. Charles E. Leeds and Alfred N. Leeds, of Eyebury, and obtained by purchase, 1890–95.

Rufford Collection. — Fossil vertebrata and plants from the Wealden of the neighbourhood of Hastings, purchased from Mr. P. Rufford, of Hastings, at various dates since 1890.

Tristram Collection.—Fossil fishes from the Cretaceous of Mount Lebanon, collected by the Rev. Canon H. B. Tristram, F.R.S., and obtained by purchase from Mr. B. M. Wright, 1865.

Ward Collection.—A large collection of fossil fishes and amphibians, chiefly from the Coal Measures of Staffordshire, purchased from Mr. John Ward, of Longton, 1894.

The following Collections have also been acquired by purchase since the Catalogue was printed (October, 1895):—

Brodie Collection.—A large collection of Triassic, Jurassic, and other fossils, comprising many type and figured specimens of fishes, made by the Rev. P. B. Brodie, M.A., of Rowington Vicarage, Warwick.

Davis Collection.—Fossil fishes chiefly from the Yorkshire Coal Measures and the Lower Lias of Lyme Regis, comprising many type and figured specimens, collected by the late Mr. James W. Davis, of Chevinedge, Halifax.

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Note to Fossilium Catalogus

I: Animalia, pars 33, W. Deecke - Pisces triadici

Nov. 1926.

Catopteridae

Pseudobeaconia bracaccinii gen et sp. nov
Trias. Argentina, A.T. Borelas 1944,
Physis 19 p. 454 pl. i. f. 1.
P. elegans o.n. do. ibid p. 456 pl. i f. 2.

SUBHOLOSTEI

Evolution in, B. Schaeffer 1956,
"Evolution" 10. 2. p. 202 2 ffs.

Rushtonaster gilli g.n.s. n. W. Bock 1959 Geol Centre Res. Ser.
p. 113 ff. 49-51 pls. 20, 21. U. Tertiary. Penn.

Class pc. Stolley 1938.

Catopterids, J. Piveteau, 1930, C.R. Acad. Sci.
Paris CXCI. p. 528.
Evolution, J. Brough 1936.

Sakamaichthys gemmini g.n.s.n. Triassic S.W.
Madagascar, J.P. Lehman et al. 1959 Ann. Paleont.
45 : 179 ff. 1, 2 Pl. i f A, B, Pl. ii.

Redfieldius, O.P. Hay, 1899, Amer. Naturalist 33, 789.

CATALOGUE

OF

FOSSIL FISHES.

PART III.

Order II. ACTINOPTERYGII (*continued*).

Suborder I. *CHONDROSTEI* (*continued*).

Family CATOPTERIDÆ.

see Agassiz 1837 p. 315.

Trunk elongate or elongate-fusiform; tail abbreviate-heterocercal. Head-bones well developed, ganoid; no median series of cranial roof-bones; teeth slender, conical; eye far forwards and snout prominent; mandibular suspensorium more or less obliquely directed backwards and downwards. A series of branchiostegal rays present. Dorsal fin single and not much extended. Scales rhombic, ganoid.

Synopsis of Genera.

Origin of dorsal fin behind that of the anal..... *Catopterus* (p. 1).
Origin of dorsal fin not behind that of the anal ..... *Dictyopyge* (p. 4).

Genus **CATOPTERUS**, J. H. Redfield.

non Ag.

[Ann. Lyceum Nat. Hist. New York, vol. iv. 1837, p. 39.]

Trunk elegantly fusiform, and head relatively small. External bones more or less ornamented with ridges and tubercles of ganoine. Fins of moderate size, consisting of robust rays, more or less enamelled, and distally bifurcating; fulcra well developed. Dorsal

and anal fins triangular, the origin of the former behind that of the latter; caudal fin forked. Scales large or of moderate size, nearly or quite smooth; dorsal ridge-scales somewhat enlarged.

A description of the known species of *Catopterus* is given by J. S. Newberry in his "Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley" (Monogr. U.S. Geol. Surv. no. xiv. 1888).

Catopterus gracilis, J. H. Redfield.

1837. *Catopterus gracilis*, J. H. Redfield, Ann. Lyceum Nat. Hist. New York, vol. iv. pp. 37–39 (? *non* pl. i.).

1841. *Catopterus gracilis*, W. C. Redfield, Amer. Journ. Sci. vol. xli. p. 27.

1888. *Catopterus gracilis*, J. S. Newberry, Foss. Fishes Trias. N. Jersey and Connecticut (Mon. U.S. Geol. Surv. no. xiv.), p. 55, pl. xvi. figs. 1–3.

Type. Nearly complete fishes; Yale College Museum, New Haven, Connecticut, U.S.A.

The type species, attaining a length of about 0·25. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and contained five times in the total length of the fish; depth of caudal pedicle somewhat less than half that of the abdominal region. Cranial bones finely granulated. Pelvic fins arising about midway between the pectorals and the anal; dorsal and anal fins nearly equal in size and almost completely opposed. Scales smooth, none deeper than broad, those of the flank in the abdominal region very finely serrated.

Some small fishes from Boonton, Middlefield, and Sunderland, named *Catopterus parvulus* (W. C. Redfield, Amer. Journ. Sci. vol. xli. 1841, p. 28; and J. S. Newberry, *op. cit.* 1888, p. 60, pl. xvi. figs. 4, 5) are probably to be regarded as the young of this species.

Form. & Loc. Triassic: Connecticut, Massachusetts, and New Jersey.

P. 7495. Greater portion of abdominal and caudal region, showing paired fins; Boonton, New Jersey. *Ward Coll.*

P. 1038. Imperfect hinder portion of the abdominal region, with the caudal region; Middletown, Westfield, Connecticut. *Egerton Coll.*

P. 1039. More imperfect specimen of the same; Durham, Connecticut. *Egerton Coll.*

P. 3515 a. Imperfect caudal region; Durham. *Enniskillen Coll.*

General remarks – Brought 1936 ofin

1901. Semionotus fultus, W. H. Hobbs (errore), 21st. Ann. Rep. U. S. Geol. Surv. pt. iii. p. 56, pl. iv. fig. B.

1905. Catopterus gracilis, C. R. Eastman, Ann. Rep. State Geol. New Jersey, 1904, p. 96, ~~pl. xiii.~~ (non pl. xiii).

1914. Catopterus gracilis, C. R. Eastman, Ann. Carnegie Mus. vol. ix. p. 144, pls. xxx, xxxi.

1917. Catopterus gracilis, C. R. Eastman, Proc. U. S. Nat. Mus. vol. 7ii. p. 280, pl. xii. figs. 1, 2; pl. xiii. figs. 1, 2.

1911. Catopterus gracilis, C. R. Eastm. Bull. 18, Connect. Geol. & N.H. Survey p. 49, ~~p~~ 56 pls ix-xi.

1959. Redfieldius gracilis in Brock Geol Cuba Res. Series Rep. 1 p. 113 pl. 48.

1906. Catopterus redfieldi, W.N. Rice, Bull. State Geol. & Nist. Surv. Connecticut, no. 6, p. 172, pl. XVII.

1911. Catopterus redfieldi, C.R. Eastm. Bull. 18, Connect. Geol. & N.H. Survey p. 51 t-fs. 5, 6.

1931. Catopterus redfieldi, J. Brough, P.Z.S., p. 271, ff. 14-15, 18.

Redfieldius obrai S. n. Trias Pennsylv. W Bock Geol Centr Rio Seven Pennsylv. 1 : 109 Hft 46, 47 pl. 19 f. 1-3. Reth. Penn. Acad Sci

Catopterus? lethicus (O. Fraas), E. Stolley, Paleontogr. vol. Ixiii (1920), pp. 65, 75. nec Semionotus leptocephalus Pictet

P. 3515. Fragment showing fine serrations on flank-scales; Durham. *Enniskillen Coll.*

Catopterus redfieldi, Egerton.

1847. *Catopterus redfieldi,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. iii. p. 278.

1888. *Catopterus redfieldi,* J. S. Newberry, Foss. Fishes Trias. N. Jersey and Connecticut (Mon. U.S. Geol. Surv. no. xiv.), p. 53, pl. xv. figs. 1–3.

Type. Nearly complete fish.

A comparatively robust species as large as the type. Length of head with opercular apparatus not more than two-thirds as great as the maximum depth of the trunk and contained nearly six times in the total length of the fish; depth of caudal pedicle equalling about one-third that of the abdominal region. Cranial bones finely granulated. Pelvic fins arising midway between the pectorals and the anal; dorsal and anal fins nearly equal in size, and the former arising opposite to the middle of the latter. Scales mostly smooth, but sometimes in part longitudinally striated, the striæ terminating in the coarse serrations of the posterior border which characterize the principal flank-scales; many of the flank-scales deeper than broad.

The so-called *Catopterus minor* (Newberry, *op. cit.* 1888, p. 57, pl. xvii.), from Durham, Connecticut, is probably founded on young individuals of this species variously distorted. It is also uncertain whether or not *Catopterus ornatus* (Newberry, *ibid.* p. 58, pl. xviii. fig. 3) must be placed here. The type is a unique, much distorted, small specimen from Durham, which seems to have been chemically eroded in such a way as to display the concentric lines of growth in the scales.

Form. & Loc. Triassic: Connecticut and New Jersey, U.S.A.

P. 3513. Imperfectly preserved specimen; Durham, Connecticut. *Enniskillen Coll.*

Vertically crushed specimens of *Catopterus*, very imperfectly preserved, seem to have been erroneously described as representing a distinct species, *Catopterus anguilliformis* (W. C. Redfield, Amer. Journ. Sci. vol. xli. 1841, p. 27, and J. S. Newberry, Mon. U.S. Geol. Surv. no. xiv. 1888, p. 59, pl. xviii. fig. 5), the type being in the Redfield Collection, Yale College Museum. The following is a specimen of this character:—

P. 1019. Imperfect, vertically-crushed remains of a large fish. Triassic; Middletown, Westfield, Connecticut. *Egerton Coll.*

Genus **DICTYOPYGE,** Egerton.

[Quart. Journ. Geol. Soc. vol. iii. 1847, p. 276.]

A group of species differing only from *Catopterus* in the more forward position of the dorsal fin, which never arises behind the origin of the anal fin.

Dictyopyge macrura (Redfield).

1841. *Catopterus macrurus*, W. C. Redfield, Amer. Journ. Sci. vol. xli. p. 27.
1847. *Dictyopyge macrura*, Sir P. ~~Egerton~~ Lyell, Quart. Journ. Geol. Soc. vol. iii. p. 276, pl. viii., pl. ix. fig. 1.
1857. *Catopterus macrurus*, W. C. Redfield, Proc. Amer. Assoc. Adv. Sci. 1856, pt. ii. p. 186.
1888. *Dictyopyge macrura*, J. S. Newberry, Foss. Fishes Trias. N. Jersey and Connecticut (Mon. U.S. Geol. Surv. no. xiv.), p. 64, pl. xviii. figs. 1, 2.

Type. Nearly complete fish; ~~British Museum~~.

The type species, attaining a length of about 0·15. Length of head with opercular apparatus somewhat less than the maximum depth of the trunk, and equalling less than one-fifth of the total length of the fish; depth of caudal pedicle less than half that of the abdominal region. Cranial bones externally ornamented with fine granulations. Pelvic fins arising midway between the pectoral arch and the anal fin; dorsal fin at least as deep as long, arising slightly in advance of the anal and scarcely smaller than the latter, which comprises about 30 rays and extends almost to the base of the caudal fin. Scales smooth, not serrated.

Form. & Loc. Triassic: Richmond Coalfield, Virginia, U.S.A.

Not represented in the Collection.

Dictyopyge socialis (Berger).

1843. *Semionotus socialis*, H. A. C. Berger, Neues Jahrb. p. 86.
1864. *Dictyopyge socialis*, J. Strüver, Zeitschr. deutsch. geol. Ges. vol. xvi. p. 322, pl. xiii. fig. 2.

Type. Nearly complete fish; University Geological Museum, Göttingen.

A large species, attaining a length of about 0·2. Length of head with opercular apparatus about equal to the maximum depth of the trunk and contained five times in the total length of the fish; depth of caudal pedicle slightly less than half that of the abdominal region. Cranial bones with an external rugose ornament. Pelvic fins arising about midway between the pectoral arch and the anal

1905. Catoplerus gracilis, C. R. Eastman; (errore), Ann. Rep. State Geologist N.Y., 1904 pl. xiii.

1911. Dictyopyge macrura, C. R. Eastman, Bull. 18, Connecticut Geol. & N.H. Survey, p. 56.

1918. Dictyopyge macrura, L. Hussakof & W.L. Bryant, Bull. Buffalo Soc. Nat. Sci. vol. xii. p. 192, pl. xxiv. fig. 3, pl. 7 xvii.

[D. Macrura - lectotype erected YPM 3707A - see Schaeffer & McDonald 1978] A.L. 1978.

P. 11129. The type specimen. [this is not the type specimen - see Schaeffer and McDonald 1978, Bull. AMNH 159 (4); p. 144

Presd by Sir Leonard Lyell, Bart, 1913.

When first came to the Museum D. M. S. Woodward as he then was, introduced me to Lord Lyell (Sir L. Lyell afterwards) told me the story of this specimen. Most of Sir Chas. Lyell's MSS seems to have been dispersed or lost after his death ~~xxxx~~ away from this specimen. A.S.W. knew Sir L. Lyell, M.P., who was Sir Chas Lyell's nephew & heir, & pressed him to look for it at his home. Eventually Sir L. Lyell noticed a curiously shaped stone, apparently black-leaded, used as a door stop in the kitchen, which on closer examination was this specimen.

E.I.W.
22.10.58.

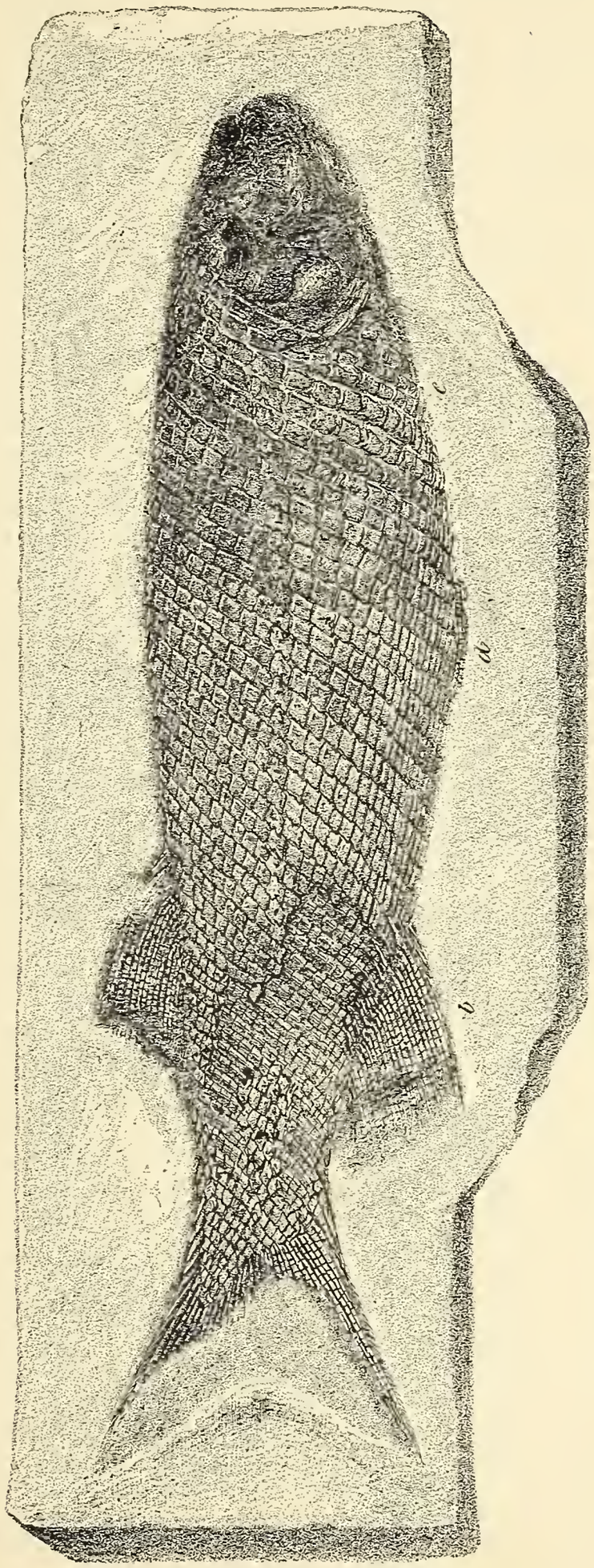


Fig. 1.

Dictyopyge macrura, lateral aspect, natural size.—Triassic: Blackheath, Virginia. (After Egerton.)

fin; dorsal and anal fins arising almost directly opposite to each other, nearly equal in size, and the latter well separated from the caudal. [Scales not satisfactorily known, but apparently serrated.]

Form. & Loc. Upper Keuper: Coburg.

P. 7395. Large slab of sandstone, with remains of several individuals; Coburg. *Purchased.*

P. 3488. Smaller slab with three specimens in an imperfect state of preservation; Coburg. *Enniskillen Coll.*

Dictyopyge catoptera (Agassiz).

1835. *Palæoniscus catopterus*, L. Agassiz, Edinb. Phil. Journ. vol. xix. p. 388.
1836. *Palæoniscus catopterus*, R. I. Murchison, Proc. Geol. Soc. vol. ii. p. 206.
1844. *Palæoniscus catopterus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 303 (name only).
1850. *Palæoniscus catopterus*, W. King, Permian Foss. (Mon. Pal. Soc.) p. 226.
1850. *Palæoniscus catopterus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. vi. p. 4.
1858. *Palæoniscus catopterus*, Sir P. Egerton, *ibid.* vol. xiv. p. 165, pl. xi. fig. 4.
1877. *Dictyopyge catoptera*, R. H. Traquair, *ibid.* vol. xxxiii. p. 567.

Type. Imperfect fishes; British Museum and Museum of Practical Geology.

A small species, attaining a length of about 0·07. Length of head with opercular apparatus at least equalling the maximum depth of the trunk and contained about five times in the total length of the fish; depth of caudal pedicle at least half that of the abdominal region. Pelvic fins arising midway between the pectoral arch and the anal fin; dorsal fin arising considerably in advance of the anal, and apparently nearly as large as the latter. Scales not satisfactorily known, but probably smooth and without serrations; many of those of the flank somewhat deeper than broad. [Narrow ventral scales not hitherto observed.]

Form. & Loc. Keuper: Tyrone, Ireland.

P. 1033. Two small slabs of red sandstone, each with two imperfect fishes; Roan Hill, Tyrone. *Egerton Coll.*

P. 3489–91. A large slab and four smaller pieces of similar sandstone with numerous specimens, one labelled by Agassiz; Roan Hill, Tyrone. *Enniskillen Coll*

P. 7395 was built 1840.

1940. *B. symm.* Lade, p. 208.

Dictyopyge superstes (Egerton).

1858. *Palæoniscus superstes*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xiv. p. 164, pl. xi. figs. 1–3.

1887. *Dictyopyge superstes*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 203.

Type. Imperfect trunk; collection of Rev. P. B. Brodie.

A small species, attaining a length of about 0·065. Proportions uncertain, but probably very similar to those of the type species, the caudal pedicle only being relatively longer. The dorsal and anal fins arising directly opposite to each other, and apparently nearly equal in size. Scales smooth, not serrated.

Form. & Loc. Upper Keuper: Warwickshire.

Not represented in the Collection.

Dictyopyge rhenana, Deecke.

1889. *Dictyopyge rhenana*, W. Deecke, Palæontogr. vol. xxxv. p. 107, pl. vi. fig. 11.

Type. Imperfect fish; Basle Museum.

A species attaining a length of about 0·13. Proportions uncertain, but probably very similar to those of the type species, the fin-rays differing in being more delicate. Dorsal fin arising slightly in advance of the anal fin. Scales smooth or marked mesially with a low longitudinal rib. (*Deecke.*)

Form. & Loc. Bunter Sandstone: Degerfelden, near Basle, Switzerland.

Not represented in the Collection.

Dictyopyge symmetrica, A. S. Woodward.

1890. *Dictyopyge symmetrica*, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 17, pl. iv. figs. 5, 6.

Type. Nearly complete fish; Geological Survey of New South Wales, Sydney.

A small species, attaining a length of about 0·08. Length of head with opercular apparatus about equal to the maximum depth of the trunk and comprised more than four times in the total length of the fish; depth of caudal pedicle scarcely more than one-third that of the abdominal region. Cranial bones externally rugose. Pelvic fins arising nearer to the anal fin than to the pectoral arch; dorsal fin as deep as long and directly opposed to the anal, which is equally elevated and only slightly more extended. Scales ornamented with faint oblique ridges or grooves.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6270. Two specimens, one wanting the head.

By exchange, 1890.

Dictyopyge illustrans, A. S. Woodward.

1890. *Dictyopyge illustrans*, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 18, pl. iv. figs. 7–9.

Type. Nearly complete fish; Geological Survey of New South Wales, Sydney.

A small species, attaining a length of about 0·09. Proportions of head and trunk as in *D. symmetrica*. Pelvic fins arising somewhat nearer to the anal fin than to the pectoral arch; dorsal fin as deep as long, almost entirely in advance of the anal, which is larger and more extended. Scales ornamented with oblique ridges or grooves.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6269. Trunk of fish, and slab with other imperfect specimens.

By exchange, 1890.

Dictyopyge robusta, A. S. Woodward.

1890. *Dictyopyge robusta*, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 20, pl. iii. figs. 4, 5.

Type. Imperfect fish; Geological Survey of New South Wales, Sydney.

A species attaining a length of about 0·09, differing only from *D. illustrans* in its more robust proportions and in the relatively greater extent of the dorsal and anal fins.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6271. Small specimen and a slab with two imperfect larger fishes.

By exchange, 1890.

Dictyopyge (?) draperi, A. S. Woodward.

1893. *Dictyopyge* (?) *draperi*, A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. xii. p. 393, pl. xvii. fig. 1.

Type. Fish, wanting caudal extremity; National Museum, Bloemfontein, Orange Free State.

A small species, attaining a length of about 0·09. Length of head with opercular apparatus about equal to the maximum depth

1940. D. i. = ? Brookvalia, Wade; p. 208.

1940. D. r. = ? Brookvalia, Wade; p. 208.

(= Palaeoniscid, Helichthys draperi, R. Broom, Ann. S. Afr. Mus. vol. vii (1909), p. 257, pl. xiii. fig. 6. not so acc. to Bough P.Z.S. 1931 p. 247.)

Ischnolepis banconsfordiensis

86

Daedalichthys liggensi, gen. et sp. nov. J. Brough, 1930, P.Z.S, Lyf. 1, P. 245 Pl. 1 f. 4. Karoo: Bakkrans Kraal. [Brit: Owen J. Brough 1936. Hb. SD. p. 392 et Heterichthys spp. and Catopterids - see vol ii. p. 470.

Dictyopyge decipiens, s.n. J. Brough P.Z.S, 1931, p. 275. Lyf. 16, Pl. IV. f. 2-3. Trias. U.S.A.; Am. N.H.:
Dictyopyge formosa, R. Broom, Ann. S. Afr. Mus. vol. vii (1909), p. 262, — Upper Karoo;

Woodichthys wilsoni g. et s.n. H. H. Swinnerton, Q.J.G.S. vol. lxxxi (1925), p. 87, Lyfs 3, pls. vii & viii. — Keuper; N. Hts. [Fish; Univ. Coll., Nottingham]. Semionotid or Lepidotid.

Brookvalia n.g., B. gracilis, B. propennis, B. parvisquamata, spp nov. R.T. Wade, 1933, Ann. & Mag. N.H. (10) XII. p. 121-124 3 Lfs. Trias. N.S.W. [Fishes: Am. Mus. G.B. Sydney. Wade 1935 p 21 -, pls. Lfs.

~~Enigmaticthys attenuatus~~
Beaconia spinosa
Dictyopleurichthys latipennis
Gaitonichthys ornatus
Molybdichthys junior
Phlyctaenichthys pectinatus
Schizurichthys pulcher
} gen. et spp. nov. M. Trias. N.S.W.

Belonorhynchus a synonym of Saurichthys, E.A. Stensiö, Kungl. Sv. Vet. Akad. Handl. vol. ii [3] (1925), p. 11. (Trias. Fishes Spitzb. vol. ii.) & puts all spp. except B. acutus & B. brevirostris in Kat genus; for the last two he creates a new Genus Acidorhynchus, p. 14.

Anatoria	semiovata	g ♂ s.u.	Sab. hastata fragm.
u	debilis	s.u	fm Trias, Argentina
Posambeya	tellecheai	g ♂ s.u.	C. Rusconi, 1946, Rev.
Caminichaia	draghii	g ♂ s.u.	Soc. Hist. Geogr. Cuyo,
Echontaia	obesa	g ♂ s.u.	1 pp. 1-12 pls. i, ii.
			[Mus. H.N. Mendoza].

Sinkiangichthys s.u. Type S. longipectoralis s.u.
L. Trias, Sinkiang. H.-t. Lin 1958. Vert. Palasiatica
2 : 149 pl. i. (Fish).

of the trunk and contained five times in the total length of the fish. External head-bones ornamented with rugæ and striæ, the mandible being longitudinally striated. Pelvic fins arising midway between the pectoral arch and the anal fin; dorsal fin at least as deep as long, arising considerably in advance of the anal fin, and smaller than the latter, which is elongated and comprises not less than 40 rays. Scales smooth, their hinder border conspicuously pectinated, except on the caudal region.

Form. & Loc. Upper Karoo Formation (Stormberg Beds): Rouxville, Orange Free State, South Africa.

Not represented in the Collection.

see p. 86

Family BELONORHYNCHIDÆ.

Brough 1936 p. 399

Trunk elongated and slender; tail abbreviate-diphycercal. Head-bones well-developed, delicately ornamented with ganoine, and those of the cranial roof forming a continuous shield, without a median longitudinal series of azygous elements; snout much elongated and slender; dentition consisting of well-spaced large conical teeth, with numerous intervening minute teeth; opercular apparatus reduced, without branchiostegal rays. Dorsal and anal fins single, remote; fulcra minute or absent. Trunk wanting a continuous squamation, but exhibiting isolated longitudinal series of scutes.

Only one definable genus of this family, *Belonorhynchus*, has hitherto been discovered; the fragments ascribed to *Saurichthys* and *Browneichthys* being too imperfect for satisfactory discussion.

Genus **BELONORHYNCHUS,** Bronn.

[Neues Jahrb. 1858, p. 12.]

Syn. *Saurorhynchus*, G. von Münster (*teste* Bronn, Nomencl.), in F. Braun, Verzeichn. Bayreuth befindl. Petrefact. 1840, p. 73 (name only).

Ichthyorhynchus, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia, 1857, p. 436.

Giffonus, O. G. Costa, Atti R. Accad. Sci. Napoli, vol. vi., Append. 1862, p. 26.

Stylorhynchus, K. Martin, Zeitschr. deutsch. geol. Ges. vol. xxv. 1873, p. 725.

Saurorhynchus, O. M. Reis, Geogn. Jahresh. 1891 (1892), p. 145.

Upper and lower jaws approximately equal in length, provided with few large conical teeth, and a close series of similar but smaller

teeth; mandible very deep posteriorly; a single opercular bone on each side. Head and opercular bones ornamented chiefly with striations, sometimes reticulated and in part tuberculated. Long, slender ribs present. Fin-rays distantly articulated; fulcra absent. Paired fins small; dorsal and anal fins large, directly opposed; caudal fin truncated behind, symmetrical. Trunk with four longitudinal series of dermal scutes, one dorsal and another ventral, and a pair supporting the "lateral line"; no intermediate scales.

The cranium in this genus is completely enveloped in membrane-bones, which are more or less fused together in the adult and firmly connected at the side in advance of the orbit with the similarly fused cheek-plates. The constitution of the cranial shield is not satisfactorily known, but it extends backwards beyond the skull to the hinder border of the operculum. The parasphenoid, as seen in side view, appears curved, the convexity being downwards; a short and broad plate extends from it on each side over the otic region; and the bone is also prolonged backwards beyond the skull to the same degree as the cranial roof already noted. The orbit is large, and there is distinct evidence of an ossified sclerotic, or at least of a hardened sclerotic ring. The nasal opening is single on each side, and obliquely elongated; and whatever appearance there may be of a second smaller opening between the latter and the orbit in certain specimens, must be regarded as deceptive. One long posterior suborbital bone is distinct, deepest behind, and produced as a narrow bar beneath the orbit; but nothing further is definitely known concerning the limits of the premaxillæ, maxillæ, and the other elements of the cheek. The hyomandibular is not much expanded at either extremity, and its long axis is nearly vertical; the quadrate is relatively large and triangular in shape. The mandible is deepest at its hinder extremity, and its posterior border descends almost vertically from the articulation with the skull. The angular and articular bones are fused together, and the expanded outer surface of the former is marked by radiating branches from the sensory canal which traverses its length. As to the limits of the dentary and splenial, there is no precise information; but the fact that a double series of large teeth extends quite to the termination of the mandible, suggests that there is no presymphysial bone. The dentition on the margin of both jaws consists of a series of large, enamel-tipped, conical teeth, well spaced, with minute intermediate teeth; and some of the inner bones of the mouth are also provided with minute teeth. A small oval operculum is attached by an articulation near the upper end of its anterior border to the hyomandibular; but there is no evidence

Bol. op. U. Dias M. Giffoni Ital. F. Barsani 1896
Pal. Ital. 2 p. 184 tb. x, xv f. 48, 49.

1959. Saurichthys striolatus, J. Griffith, P.Z.S.
132, 4 : 588 fg. 1-6 pl. i.

of any other ossification either in the opercular or branchiostegal membrane.

The notochord is persistent, and there are no undoubted ossifications in the notochordal sheath. The neural and hæmal arches, however, are much expanded, the former united by zygapophyses and bearing short delicate spines, the latter in the caudal region symmetrical with the neurals. Long slender ribs are also observed in the Australian specimens.

The paired fins are small, apparently exhibiting a very feeble lobation, and consisting of delicate rays. The clavicle is also relatively small and sickle-shaped, with a triangular plate affixed to its postero-inferior border; the pelvic fin-supports are unknown. The dorsal and anal fins exhibit a series of robust supports much less numerous than the dermal rays; and neither on these nor on any other fins are there indications of fulcra.

The longitudinal series of dermal scutes, forming dorsal and ventral ridges and a support for the lateral line, are more or less A-shaped and deeply imbricating, sometimes broad and tuberculated, sometimes narrow and smooth. The ventral series divides to form a ring round the anus. The present writer has not observed any distinct evidence of intermediate scales or calcifications.

The species of *Belonorhynchus* are distinguished chiefly by differences in the relative proportions of the head and trunk, in the form, proportions, and ornamentation of the head and scutes.

Belonorhynchus striolatus, Bronn.

1858. *Belonorhynchus striolatus*, H. G. Bronn, Neues Jahrb. p. 12, pl. i. figs. 1–10, pl. ii. fig. 1.

1866. *Belonorhynchus striolatus*, R. Kner, Sitzungsb. k. Akad. Wiss. Wien, math.-naturw. Cl. vol. liii. pt. i. p. 189, pl. vi.

1892. *Saurichthys striolatus*, O. M. Reis, Geogn. Jahresh. 1891, p. 148, fig. 5.

Type. Nearly complete fishes.

The type species, of small size, attaining a maximum length of about 0·15. Snout extremely attenuated, the head and opercular apparatus occupying about two-fifths of the total length; facial bones marked with prominent vertical striations; operculum about as deep as broad. Space between the pectoral and pelvic fins more than twice as great as that between the latter and the anal. Scutes of dorsal and ventral series narrow and slender, much elongated on the caudal pedicle; scutes of lateral line relatively small.

Form. & Loc. Upper Keuper: Raibl, Carinthia.

33061. Imperfect specimen, coiled up and wanting the paired fins. *Purchased*, 1858.

P. 966. Typical specimen, displaying the sclerotic plates and remains of all the fins. A pair of plates, not readily determinable, in front of the pectoral fins, are doubtfully regarded as infraclaviculars in Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 22. *Egerton Coll.*

P. 966 a, P. 3789 a. Imperfect specimen in counterpart, exhibiting the paired fins and the oval ring of scutes between the pelvic pair. *Egerton & Enniskillen Colls.*

P. 3789. Specimen showing the great elongation of the snout and several characters of the trunk, notably the elongation of the dorsal and ventral scutes on the caudal pedicle. *Enniskillen Coll.*

Belonorhynchus gracilis, A. S. Woodward.

1890. *Belonorhynchus gracilis*, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 27, pl. viii. fig. 5, pl. ix. figs. 3, 4, pl. x. figs. 3, 4.

1892. *Saurichthys gracilis*, O. M. Reis, Geogn. Jahresh. 1891, p. 155.

Type. Imperfect fish: Geological Survey of New South Wales, Sydney.

A species of moderate size. Head with opercular apparatus occupying about one quarter of the total length; facial bones marked with prominent vertical striations, and mandible longitudinally striated. Scutes of dorsal and ventral series narrowly ovate, much longer than broad, acuminate behind, and apparently tuberculated; scutes of lateral line relatively small.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6273. Portion of trunk, with dorsal fin. *By exchange*, 1890.

Belonorhynchus gigas, A. S. Woodward.

1890. *Belonorhynchus gigas*, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 23, pl. ix. figs. 1, 2, pl. x. figs. 1, 2.

1892. *Saurichthys gigas*, O. M. Reis, Geogn. Jahresh. 1891, p. 155.

Type. Imperfect fish; Geological Survey of New South Wales, Sydney.

A species of large size, attaining a length of not less than 0·5. Head with opercular apparatus occupying about one-third of the total length; facial bones marked with prominent vertical striations.

?1873. Ichthyorhynchus carinii O.G. Costa, Ittiol. fos. Ital. p. 63. Cron. pl. v. f. 2

1910. Belonorhynchus robustus, G. De Alessandri, Mem. Soc. Ital Sci. Nat. vol. vii. p. 54. pl. iv. figs. 1, 2.

Scutes of dorsal and ventral series about twice as broad as long, obtusely pointed behind, and ornamented with prominent tuberculations; scutes of lateral line comparatively small; all the scutes much enlarged on the short and narrow caudal pedicle.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6272. Two fragments of trunk. *By exchange*, 1890.

Belonorhynchus macrocephalus, Deecke.

See p. 18 →

(?) 1857. *Ichthyorhynchus curioni*, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia, p. 436.

(?) 1886. *Belonorhynchus* cfr. *robustus*, F. Bassani (*ex* Bellotti, MS.), Atti Soc. Ital. Sci. Nat. vol. xxix. p. 33. [Portions of head and trunk; Milan Museum.]

1889. *Belonorhynchus macrocephalus*, W. Deecke, Palæontogr. vol. xxxv. p. 127, pl. vii. figs. 1, 2.

1892. *Belonorhynchus macrocephalus*, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, p. 6.

1892. *Saurichthys macrocephalus*, O. M. Reis, Geogn. Jahresh. 1891, p. 154, fig. 9.

Type. Imperfect fish.

A species of large size, attaining a length of not less than 0·45. Head with opercular apparatus occupying about one-third of the total length; cranial roof tuberculated, and facial bones marked with prominent vertical striations; operculum deeper than broad. Scutes of dorsal and ventral series elongated, triangular, not much enlarged on the caudal pedicle; scutes of lateral line smaller, rhombic in form.

Form. & Loc. Keuper: Lombardy.

Not represented in the Collection.

Belonorhynchus tenuirostris (Münster).

1710. Figures by Buttner, Rudera diluvii testes, pl. xvi. fig. 9, pl. xxiii. fig. 3, pl. xxiv. B. fig. 1.

1839. *Saurichthys tenuirostris*, G. von Münster, Beitr. Petrefakt. pt. i. p. 118, pl. xiv. fig. 3.

1840. *Saurorhynchus tenuirostris*, F. Braun, Verzeichn. Bayreuth befindl. Petrefact. p. 73.

1846. *Saurorhynchus tenuirostris*, E. E. Schmid, in Schmid & Schleiden, Geogn. Verhält. Saalthals, p. 37, pl. iii. figs. 4, 5.

1849. *Saurichthys tenuirostris*, H. von Meyer, Palæontogr. vol. i. p. 201, pl. xxxi. figs. 29–32.

1861. *Saurichthys tenuirostris*, E. E. Schmid, Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, p. 24.

1865. *Saurichthys tenuirostris*, H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien, p. 121.

1873. *Stylorhynchus tenuirostris*, K. Martin, Zeitschr. deutsch. geol. Ges. vol. xxv. p. 725, pl. xxii. fig. 14.

1888. *Saurichthys tenuirostris*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 266.

1892. *Saurichthys tenuirostris*, O. M. Reis, Geogn. Jahresh. 1891, p. 151, (?) fig. 4.

Type. Cranium; Palæontological Museum, Munich.

The type species of the so-called *Saurorhynchus* (Münster MS.) and *Stylorhynchus*, of small size and with very slender snout, the head attaining a length of about 0·06 and its maximum breadth 0·01. The external ornament of the cranial roof consists chiefly of tubercles.

Form. & Loc. Muschelkalk: Germany.

Not represented in the Collection.

Belonorhynchus acutus (Agassiz).

[Plate II. fig. 1.]

1844. *Belonostomus acutus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 142, pl. xlvii *a*. figs. 3, 4.

1844. *Belonostomus anningiæ*, L. Agassiz, *ibid.* p. 143 (name only). [Head; British Museum.]

1844. *Belonostomus tenellus*, L. Agassiz, *ibid.* p. 143 (name only). [Mandibular symphysis; British Museum.]

1858. *Belonorhynchus* (?) *acutus* and *B.* (?) *anningiæ*, H. G. Bronn, Neues Jahrb. p. 12.

1876. *Belonostomus acutus*, J. F. Blake, in Tate and Blake, Yorkshire Lias, p. 259.

1887. *Belonorhynchus acutus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 222.

1888. *Belonorhynchus anningiæ*, A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. i. p. 355, and Quart. Journ. Geol. Soc. vol. xliv. p. 147, pl. vii. fig. 14.

1890. *Belonorhynchus acutus*, Woodward and Sherborn, Catal. Brit. Foss. Vertebrata, p. 16.

1892. *Saurorhynchus acutus*, O. M. Reis, Geogn. Jahresh. 1891, p. 145 (in part).

Type. Imperfect cranium; British Museum.

The type species of the so-called *Saurorhynchus*, of moderate size, the head attaining a length of about 0·15. Head from four and a half to five times as long as its maximum depth; distance between the orbit and the occiput considerably exceeding the maximum depth of the mandible, and the angular bone of the latter much truncated though gently rounded postero-inferiorly; dentition

P. 8634. Skull roof from below. Described E. A. Stensiö "Trias. fishes Spitzb." pt. ii, Kungl. Sv. Vet. Akad. Handl. [3] vol. 2 (1925) p. 179; Muschelkalk, Rautkalk nr Jena. Purchased, 1897.

P. 10614. Cast of cranial cavity from above descr. & fig. E. Stensiö tom. cit. p. 176 t-f. 57. [ibid.] pres. Prof. G. Linck. 1908.

1898. Belonorhynchus acutus, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii. p. 45-6.

1921. Belonorhynchus acutus, B. Haupt, Paläontogr. vol. lxiv. p. 31.

1925. Acidorhynchus acutus, A. Stensiö tom. cit p. 13.

1960 Saurorhynchus acutus (Agassiz), Gardiner, B. G., Bull. Brit. Mus. (Nat. Hist.) Geol. 4: 272, figs 19-22

P. 4268. Des? Lv. wl. 1898, p. 458.

powerful; superficial ornament consisting of short rugæ, the majority directed longitudinally. Operculum two-thirds as broad as deep. Scutes of dorsal and ventral series long, narrow, and slender, apparently smooth.

Form. & Loc. Upper Lias: Yorkshire. Lower Lias: Dorsetshire.

Except the first, all the following specimens were obtained from Lower Lias of the neighbourhood of Lyme Regis.

P. 4268. Type specimen, being the fragmentary cranium figured by Agassiz, *loc. cit.* fig. 4; Upper Lias, Whitby.
Enniskillen Coll.

P. 428. Crushed and somewhat fractured head, lateral aspect, measuring 0·145 in length, but wanting the extremity of the snout. The laniary teeth gradually become more and more robust backwards, and those of the two jaws alternate, fitting into broad notches; the clusters of minute intervening denticles are conspicuous. The imperfectly preserved angular bone of the mandible is shown to be continuous with the articular element. *Purchased*, 1882.

43054. Smaller head, 0·1 in length, the cranium much crushed but showing the extension of the roof-bones beyond the occiput posteriorly. The jaws are almost of equal length, the mandible being not more than 0·002 shorter than the upper jaw. The angular bone displays its truncated but gently rounded postero-inferior border, and also exhibits the series of vertically-extended markings due to the perforations of a sensory canal. *Purchased*, 1871.

P. 3791. A fine example of the head, with left operculum and clavicle, shown of the natural size in Pl. II. fig. 1. Besides displaying the general proportions, this specimen also exhibits a few details, notably the post-occipital extension of the cranial roof (*r.*), the presence of cheek-plates, the position of the narial opening (*n.*), and the form of the articulo-angular bone. The operculum (*op.*) is nearly one and a half times as deep as broad, tapering downwards, and evidently not succeeded either by a sub-operculum or branchiostegal rays. The clavicle (*cl.*) is deep, narrow and gently arched, with a relatively large but narrow triangular plate extending far backwards from the hinder border. *Enniskillen Coll.*

P. 965. Somewhat smaller head, lateral aspect, with operculum and clavicle. *Egerton Coll.*

P. 935 a. Much crushed and fractured small head, lateral aspect. *Egerton Coll.*

P. 4271. Similar specimen. *Enniskillen Coll.*

47462. Imperfect remains of head, displaying the parasphenoid bone in side view, and one of the suborbital plates. In its posterior portion the parasphenoid exhibits a large ascending lateral plate. *Purchased*, 1876.

48007. Imperfect cranium in side view, showing the orbit, narial opening, and the dentition with the notches for the reception of the lower laniaries. *Purchased*, 1887.

40499. Small cranium, upper aspect. *Purchased*, 1867.

P. 964. Portion of similar cranial roof, labelled *Belonostomus tenellus* by Agassiz. *Egerton Coll.*

P. 965 b. Mandible, lateral aspect, showing part of the dentition and the superficial rugose ornament, and the continuity of the articular with the angular bone. *Egerton Coll.*

P. 965 c. Imperfect small mandible, oral aspect, exhibiting a sharp median longitudinal ridge on the long symphysis. *Egerton Coll.*

P. 513. Symphysial portion of mandible, labelled *Belonostomus tenellus* by Agassiz, and intended to be the type specimen of that undefined species. On account of the form of the fractured extremity, this fossil was described and figured as a presymphysial bone by the present writer in the Quart. Journ. Geol. Soc. vol. xliv. p. 147, pl. vii. fig. 14; but such a determination is very doubtful and not confirmed by any other specimen. *Egerton Coll.*

P. 3790. Head and remains of trunk, without fins, noticed by the present writer in Ann. Mag. Nat. Hist. [6] vol. i. p. 355, and three of the dorsal scutes figured in Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, pl. viii. fig. 7. The head exhibits the typical characters of the species, and the mandible is scarcely shorter than the upper jaw. Portions of the operculum and clavicle are preserved, and remains of the axial skeleton of the trunk occur beyond. The neural arches are very broad and bear short slender neural spines, which may have become elongated in the caudal region to be symmetrical with the hæmals, of which a few

P. 964. Notice of C. A. Stensiö "Triassic Fishes Spitzb. Pt. ii (1925) p. 179.

Gymnosaurichthys Berg. 1940

1898. Belonorhynchus brevirostris, A.S. Woodward, Proc. York. Geol. Polyt. Soc. vol. xiii. p. 459, text-fig. 1.

1925. Acidorhynchus brevirostris, E.O. Stensiö, Kom. cit. p. 13.

1938. " " B. Haughton jun. Pal. Zeits. XX. p. 214, fig. 3-7, pls. 22-26.

1940. Gymnosaurichthys brevirostris L. Berg, "Class" Pisces, Osn. Paleont. Zool. Moscow pp. 194, 408.

1952. Fc. Gr. B. Haughton, Hofmanden Zool. p. 22 pl. 41

1959. Fc. Gr. F. Heller Geol. Blätter Nordost-Bayern 9 146 2 figs (L. jun. Francona).

are shown. There are no satisfactory indications either of ribs or fins; and only fragments of the dorsal series of ridge-scutes are preserved. *Enniskillen Coll.*

P. 965 d. Imperfect mandible, much ornamented, with part of the series of arches of the axial skeleton of the trunk. *Egerton Coll.*

Belonorhynchus brevirostris, sp. nov.

[Plate II. fig. 2.]

1858. *Belonostomus acutus*, F. A. Quenstedt (*errore*), Der Jura, p. 234, pl. xxix. fig. 8.

1892. *Saurorhynchus acutus*, O. M. Reis, Geogn. Jahresh. 1891, p. 145 (in part), figs. 1–3.

Type. Head; British Museum.

A species of moderate size, the head attaining a length of about 0·11. Head from three and a half to four times as long as its maximum depth; distance between the orbit and occiput scarcely if at all exceeding the maximum depth of the mandible, and the angular bone of the latter with long, nearly vertical hinder border, sharply rounded off inferiorly; dentition powerful, the posterior laniaries widely spaced and especially robust; superficial ornament consisting of short rugæ, the majority directed longitudinally. [Trunk unknown.]

Form. & Loc. Lower Lias: Dorsetshire. Upper Lias: Würtemberg and Yorkshire.

(i.) *Lower Lias, Lyme Regis.*

40726. Type specimen, being a cranium and mandible wanting the extremity of the snout and marked by an oblique line of fracture across the hinder portion. The fossil is shown of the natural size in Pl. II. fig. 2, and exhibits the principal characters of the head from the right lateral aspect. Remains of the posterior extension of the cranial roof (*r.*) occur above the operculum (*op.*), which is very small and similar in shape to that of *B. acutus*. The orbit (*o.*), narial opening (*n*), and dentition are also indicated; and the form of the hinder portion of the mandible is especially well shown. The very large articulo-angular bone exhibits the form of the posterior and postero-inferior margin so characteristic of the species; and there are abraded remains of the series of short vertical sensory canals which mark its upper border. *Purchased*, 1867.

39866. Small head 0·055 in length, the maximum depth contained about three times in the total length, and the mandible

slightly shorter than the upper jaw. The superficial rugæ on the articulo-angular bone appear to be directed vertically. *Purchased*, 1866.

P. 4878. Well-preserved head 0·075 in length. *Purchased*, 1885.

P. 3791 b. Crushed head 0·088 in length, displaying the dentition and the articulo-angular bone of the mandible. *Enniskillen Coll.*

P. 3791 a. Hinder portion of skull and mandible with well-preserved laniary teeth. Portions of the right operculum, clavicle, and some of the neural arches of the trunk are preserved behind. *Enniskillen Coll.*

43008. Mandible, left outer aspect, with teeth. *Purchased*, 1871.

(ii.) *Upper Lias, Whitby.*

39153. Abraded skull and mandible 0·095 in length, right lateral aspect; probably obtained from Whitby. *Bowerbank Coll.*

(iii.) *Upper Lias, Würtemberg.*

P. 3792. Head about 0·11 in length, somewhat fractured and displaying part of the parasphenoid; Ohmden. *Enniskillen Coll.*

P. 960. Nearly similar specimen; Ohmden. *Egerton Coll.*

P. 960 a. Remains of skull and mandible showing the hinder half of the parasphenoid and part of the right quadrate; Ohmden. Minute conical teeth appear in side view either on the parasphenoid or on the vomer. *Egerton Coll.*

P. 960 b. Four imperfect heads; Ohmden. *Egerton Coll.*

20660–61. Two imperfect heads; Boll. *Purchased*, 1846.

The following species have also been partially defined, the two last without figures:—

Belonorhynchus gypsophilus: *Saurichthys gypsophilus*, O. M. Reis, Geogn. Jahresh. 1891 (1892), p. 153, fig. 6.—Keuper; Altenmünster, N. Franconia. [Portion of upper jaw.]

Belonorhynchus intermedius, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. (1886), p. 34.—Keuper; Besano, Lombardy. [Hinder portion of trunk; Milan Museum.]

Belonorhynchus stoppanii, F. Bassani, *ibid.* p. 34.—*Ibid.* [Nearly complete fish; Milan Museum.]

39153. Des? d fig? A.S.W. loc. cit. 1898, p. 459, text-fig. 1.

P. 3792 } Noticed E. A. Stensiö (tom. cit. 1925) p. 176.
P. 9606 }

Saurichthys curionii, J. Griffith 1857 P.Z.S. 132, 4: 599 t-f. 7, pl. ii.
Belonorhynchus curionii, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 59, pl. iv. fig. 3. (sep. 13)
Belon. dayi.

Belon. gypsophilus, G. De Alessandri, loc. cit. 1910, p. 64.

Belon. intermedius, G. De Alessandri, loc. cit. 1910, p. 65, pl. iv. fig. 5.
Belon. stoppanii, G. De Alessandri, loc. cit. 1910, p. 62, pl. iv. fig. 4.
Belonorhynchus wimani, A. S. Woodward, Bull. Geol. Inst. Upsala, vol. xi (1912), p. 293, pl. XIV. figs. 3–6. — Lower Trias; Sassen Bay, Spitsbergen. [Head, d.; Geol. Inst. Univ. Upsala.]
Saurichthys wimani, E. A. Stensiö, tom. cit. 1925, p. 133, pls. 17–20. pl. 26, f. 6, 9a. 35, 36a, 37–42.

Belonorhynchus deperditus (Costa), G. De Erasmo. Atti R. Accad. Sci. Napoli [2] vol. xvi (1914), no. 1, p. 3, text-figs. 1, 2.

(?) Belonorhynchus? sp., C. R. Eastman, Proc. U.S. Nat. Mus. vol. 7ii (1917), p. 281. — Hawkesbury Series; Gosford, N.S. Wales.
Saw fragm. to Rst von Rudersdorf, M. Hilgheimer 1930° Hf. (2 vals. saw).

F. Frech, Lett. geogn., Trias, p. 58.
E. Hennig, Centralbl. f. Min. etc. 1909, p. 541, text-figs. 1–3.

1928° S. apicalis, G. F. Oertle, p. 374, pl. xxxi f. 11.

Saurichthys ver. in no. of species is L. Beltan 1958. CR Acad. Sci. Paris 247 p. 1636 2 figs.

As pointed out by K. A. von Zittel, Handb. Palæont. vol. iii. (1888), p. 266, the imperfect head of an undetermined large species of *Belonorhynchus* from the Rhætic of Seefeld, Tyrol, is also described as *Teleosaurus tenuistriatus*, R. Kner, Sitzungsb. k. Akad. Wiss. Wien, math.-naturw. Cl. vol. lvi. (1867), pt. i. p. 905, pl. iii.

Fragments of another undetermined species from the Trias of Monte Pettine, near Giffoni, Province of Salerno, Italy, now in the Museum of the University of Naples, are described by O. G. Costa, Atti R. Accad. Sci. Napoli, vol. vi. Append. (1862), under the names of *Giffonus deperditus* (*loc. cit.* p. 26, pl. vi. fig. 2) and *Acipenser*? (*ibid.* p. 44, pl. vii. figs. 6 A, B). Others are described as *Palæoniscus*? (Atti Accad. Pontan. vol. vii. 1856, pp. 36, 358, pl. iv. fig. 5). These are referred to *Belonorhynchus* sp. by F. Bassani, Fossili Schisti Bitumin. Monte Pettine (Mem. Soc. Ital. Sci. ser. 3, vol. ix. no. 3, 1892), pp. 5–7.

from S. sp. Campione Z. Kuhn 1942 Eclog. Geol. Helv. 34 p. 296.

Genus **SAURICHTHYS,** Agassiz.

[Neues Jahrb. 1834, p. 386.]

Syn. *Thelodus*, E. E. Schmid, Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, 1861, p. 27 (in part).

An indefinable genus known only by detached teeth and fragments of jaws. The teeth are enamelled only in their distal portion, and their base is sometimes feebly plicated. The bones are ornamented chiefly with fine tuberculations, though in part striated.

The fish to which these remains belong may be generically identical with *Belonorhynchus*, as suggested by Reis (Geogn. Jahresh. 1891, p. 149); but until proof be forthcoming, it seems inadvisable to change the nomenclature.

Saurichthys apicalis, Agassiz.

1834. *Saurichthys apicalis*, L. Agassiz, Neues Jahrb. p. 387.
1839. *Saurichthys apicalis*, G. von Münster, Beitr. Petrefakt. pt. i. p. 117, pl. xiv. figs. 1, 2.
1844. *Saurichthys apicalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 85, pl. lv. *a*. figs. 6–11.
1849. *Saurichthys apicalis*, H. von Meyer, Palæontogr. vol. i. p. 234, pl. xxviii. fig. 31.
1855. *Saurichthys apicalis*, C. G. Giebel, Odontogr. p. 113, pl. xlv. fig. 1.
1856. *Saurichthys mougeoti*, C. G. Giebel (*errore*), Zeitschr. f. gesammt. Naturw. vol. viii. p. 425, pl. i. fig. 4.
1861. *Saurichthys acuminatus*, E. E. Schmid (*errore*), Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, p. 21, pl. iii. figs. 20–26 (*non* figs. 18, 19).

1865. *Saurichthys apicalis*, H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien, p. 69.
1888. *Saurichthys apicalis*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 266, fig. 271.
1892. *Saurichthys apicalis*, O. M. Reis, Geogn. Jahresh. 1891, p. 153, fig. 8.

Type. Portion of upper jaw; Palæontological Museum, Munich.

The type species, with much elongated jaws and slender teeth, the head attaining a length of about 0·012. Apical gano-dentine smooth, not usually extending below the distal third of the tooth; base finely striated.

Form. & Loc. Muschelkalk and Lower Keuper: Germany.

Not represented in the Collection.

Saurichthys mougeoti, Agassiz.

1834. "Zähne von Göttingen," H. von Meyer, Mus. Senkenberg. vol. i. p. 16, pl. ii. figs. 4–6.
1837. Figure by H. B. Geinitz, Beitr. Kennt. Thüring. Muschelk. pl. iii. fig. 2.
1837. *Saurichthys mougeotii*, H. Hogard, Descript. Système des Vosges, p. 405, pl. xii. figs. 14 (also 16, 20).
1837. *Saurichthys conidens*, H. Hogard, *ibid.* p. 406, pl. xii. fig. 15.
1839. *Saurichthys semicostatus*, G. von Münster, Beitr. Petrefakt. pt. i. p. 118. [Teeth; Palæontological Museum, Munich.]
1844. *Saurichthys mougeoti*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 85, pl. lv. *a*. figs. 12–15.
1849. *Saurichthys mougeoti*, H. von Meyer, Palæontogr. vol. i. pp. 203, 235, pl. xxviii. figs. 21–30.
1852. *Saurichthys mougeoti*, F. A. Quenstedt, Handb. Petrefakt. p. 231, pl. xiii. fig. 56.
1861. *Saurichthys acuminatus*, E. E. Schmid (*errore*), Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, p. 21, pl. iii. figs. 18, 19.
1861. *Saurichthys apicalis*, E. E. Schmid (*errore*), *ibid.* p. 22, pl. iii. figs. 13–17.
1865. *Saurichthys mougeoti*, H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien, p. 120.
1873. *Saurichthys mougeoti*, K. Martin, Zeitschr. deutsch. geol. Ges. vol. xxv. p. 723, pl. xxii. fig. 15.
1892. *Saurichthys mougeoti*, O. M. Reis, Geogn. Jahresh. 1891, p. 154.

Type. Portion of jaw.

A more robust and larger species than the type. Apical gano-dentine occupying more than one-third of the length of the tooth, except in the shorter and stouter examples; both the base and at least part of the apex marked with coarse longitudinal ribs and fine striations.

Form. & Loc. Muschelkalk and Lettenkohl: France and Germany.

1907. Saurichthys acuminatus, H. E. Sauvage, in P. Thiéry, Note sur l'Infralias de Provenchères-sur-Meuse (Chaumont, 1907), p. 12, pl. iii. figs. 13, 14.

Birgeria Stensiö 1919.

See also p. 526 vol. iii.

Typ. S. mougeoti (Vill.) Jordan (see p. 399) acc. to Stensiö Trias. Fish. E. Greenland p. 98.)

S. sp. fm. S. Madagascar S. Guffroy, 1907 Bull. Soc. géol. France (4) 6 p. 240 fig. 1, pl. XXIX a

1938. Birgeria mougeoti Gultormsen p. 6. fig. 1. 3 (B. sp. 1-5).

~~Birgeria dawsoni Johan sp. nov.~~

1919. Birgeria mougeoti, E. A. Stensiö, Senckenbergiana, vol. i. p. 178, text-figs. 1-3. [T. of Birgeria, referred to Paleoniscidæ. M. Trias, Spitzbergen.]

1921. Birg. moug. E. A. Stensiö, Triassic fishes fm Spitzbergen, p. 157, pl. 20, fig. 6; pl. 21; pl. 22, figs. 1-3; pl. 23, figs. 1-3; pl. 24, figs. 1, 2; & figs. 57-68.

1928. Saurichthys mougeoti, G. F. Oertle, p. 372, pl. xxxi. (2-15)

1929, ~~Saurichthys~~ Birgeria mougeotti, G. Corroy, Ann. Paléont. XVII. p. 99, pl. xii. f. 16-19.

1932. Birgeria mougeoti, Stensiö. T. F. E. G. p. 98 figs. 37-39.

1856. B. acuminatus S. Gracia, Sci. Terc $\frac{S}{T}$ p 32 pl. iii f. 1 Rhaetian

1876. Saurichthys striatulus, J. Henry, Mém Soc. d'Emulation du Doubs [4] vol. X, p. 414, pl. ii, fig. 16.

1876. Saurichthys subulatus, J. Henry, ibid. p. 414, pl. ii, fig. 17.

1876. Saurichthys aculeatus, J. Henry, ibid. p. 414.

1892. Saurichthys acuminatus, F. Bassani, Rendic. R. Accad. Lincei [5] vol. i. p. 285.

1930. S. a. S. Tommasi, p. 48 (Calcinelle Giulia).

1907. Saurichthys acuminatus, H. E. Sauvage, Note sur l'Infralias de Provenchères-sur-Meuse (Chaumont, 1907), p. 12, pl. iii, figs. 13, 14.

1908. Saurichthys acuminatus, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont.), p. 12, text-fig. 6.

1929. Birgeria acuminata, G. Corroy, Ann. Paleont. XVII. p. 99. pl. xii. f. 20-23.

1937. Birgeria acuminata, A. Bossi, p. 534. ii. 1-2; iii, 1-2; v. 2, 6 vi. t. S. 17. 1-2 14.

Birgeria sp. G. Corroy, 1929. Ann. Paleont. XVII. p. 100. pl. xi. f. 11.

1536–39. Five teeth; Laineck, near Bayreuth, Bavaria.
Braun Coll.

P. 853. Robust tooth; Laineck. *Egerton Coll.*

P. 854. Robust and coarsely ribbed tooth; Mattstedt, near Jena.
Egerton Coll.

Saurichthys acuminatus, Agassiz.

1843. *Saurichthys apicalis*, J. E. Portlock (*errore*), Rep. Geol. Londonderry, p. 470, pl. xiv. fig. 19.
1844. *Saurichthys acuminatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 86, pl. lv. *a*. figs. 1–5.
1844. *Saurichthys longidens*, L. Agassiz, *ibid.* p. 87, pl. lv. *a*. figs. 17, 18. [Tooth from Aust Cliff.]
1844. *Saurichthys acuminatus*, Meyer & Plieninger, Pal. Württembergs, p. 118, pl. xii. fig. 30.
1844. *Saurichthys mougeoti*, Meyer & Plieninger, *ibid.* p. 118, pl. xii. figs. 31, 32.
1844. *Saurichthys breviconus*, T. Plieninger, in Meyer & Plieninger, *op. cit.* p. 120, pl. xii. fig. 83. [Tooth; Stuttgart Museum.]
1844. *Saurichthys longiconus*, T. Plieninger, *ibid.* p. 119, pl. xii. figs. 90, 91. [Teeth; Stuttgart Museum.]
1844. *Saurichthys listroconus*, T. Plieninger, *ibid.* p. 120, pl. xii. fig. 81. [Tooth; Stuttgart Museum.]
1858. *Saurichthys acuminatus*, F. A. Quenstedt, Der Jura, p. 35, pl. ii. figs. 42–51.
1872. *Saurichthys acuminatus* and *S. apicalis*, R. Etheridge, Proc. Cardiff Naturalists' Soc. vol. iii. pl. ii. figs. 5–10.
1878. *Saurichthys acuminatus*, B. Lundgren, Minneskr. Kongl. Fysiogr. Sällsk. Lund, no. v. p. 31, pl. ii. figs. 60, 61.
1888. *Saurichthys acuminatus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 266, fig. 272.
1889. *Saurichthys acuminatus*, A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. iii. p. 301, pl. xiv. figs. 7, 8; and Trans. Leicester Lit. & Phil. Soc., n. s., vol. i. pt. xi. p. 20.

This name may be provisionally retained for the teeth of *Saurichthys* from the Rhætic horizons of N.W. Europe. They indicate a species with a robust dentition, the more typical teeth only differing from those named *S. mougeoti* in the relatively shorter basal portion and the prominence of the inferior rim of the apical gano-dentine. The extreme variations in the form of the teeth are pointed out by Quenstedt; and *S. longidens* is proved to be a synonym of *S. acuminatus* by an imperfect maxilla from Aust Cliff described in Ann. Mag. Nat. Hist. [6] vol. iii. p. 301, pl. xiv. figs. 7, 8.

Form. & Loc. Rhætic: N.W. Europe. Trias: Friuli, Italy.

11205, 11209. Two teeth in matrix; Aust Cliff, near Bristol. *Mantell Coll.*

23353, 23812. Portions of bone-bed with teeth, and detached teeth; Aust Cliff. *Purchased*, 1849.

44835 a. Bone-bed with two teeth; Aust Cliff. *Presented by Benjamin Bright, Esq.*, 1873.

P. 855–6. Six teeth, three being in matrix; Axmouth, Devonshire. *Egerton Coll.*

P. 3479. Two teeth in matrix; Axmouth. *Enniskillen Coll.*

P. 857 a. Tooth in bone-bed; Newtown Limavady, Londonderry, Ireland. *Egerton Coll.*

28473–74, 28477. Several detached teeth; Crailsheim, Würtemberg. *Purchased*, 1853.

P. 857. Tooth in bone-bed; Hohenheim, Würtemberg. *Egerton Coll.*

The following names have also been applied to detached teeth, of which there are no examples in the Collection:—

Saurichthys annulatus, T. C. Winkler, Archiv. Mus. Teyler, vol. v. (1880), p. 132, pl. viii. figs. 31–34.—Muschelkalk; Wurzburg. [Wurzburg University Museum.]

Saurichthys breviceps, F. A. Quenstedt, Handb. Petrefakt. (1852), p. 231, pl. xiii. fig. 57.—Lettenkohl; Crailsheim, Würtemberg. [Tübingen University Museum.]

? acuminatus acc. G. F. Oertle 1928 p. 375.

Saurichthys costatus, G. von Münster, Beitr. Petrefakt. pt. i. (1839), p. 118; H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien (1865), p. 121: *Thelodus rectus*, E. E. Schmid, Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9 (1861), p. 28, pl. iv. figs. 20–22.—Upper Muschelkalk; Bayreuth, Bavaria, also Jena.

Birgeria costata, G. Bonci, 1937, p. 591, pl. v. f. 1, 8.

A dentigerous bone, also probably of *Saurichthys*, from the Muschelkalk of Poland, is assigned to an undetermined species of this genus by H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien (1865), p. 69, pl. ii. fig. 5. The specimen is preserved in the Breslau University Museum, and exhibits a pavement of blunt conical teeth.

Other portions of jaws from the Muschelkalk of Jena, described as *Saurichthys procerus* and *Saurichthys? gracilis* by E. E. Schmid (Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, 1861, p. 23, pl. iii. figs. 27, 28), do not appear to pertain to this genus. The same remark applies to some detached teeth from the Carboniferous of the Punjab, India, described under the name of *Saurichthys? indicus*,

Saurichthys krambergeri, Schlosser.

1918. -- M. Schlosser in Zittel's Grundzüge Paläont. ed. 3, pt. ii. p. 94, fig. 158.

1925. S.K. Stensiö Trans R. Spitsb. pp. 180, 181.

Type. Nearly complete fish; Pal. Mus. Munich.

Loc. & Loc. U. Trias: Adnet, near Salzburg.

[Figure only, no definition.]

S. stensioi s.n. Estrias, Madagascar J.P. Lehman 1952 (cited) p. 120 ff. 77, 78 pl. 35 AE.

Saurichthys parvidens, n.s. ? Trias N.S.W.

Saurichthys megalaris, n.s. G.F. Oertle, 1928, p. 375 pl. Trias (? Muschelkalk) Württemberg.

†*Saurichthys seefeldensis* **nom. n.** = *S. tenuistriatus* Knev *nec* Münster, STRAND Arch. Naturg. **92** A. 8 p. 54.

Saurichthys latifrons, F. Frech,

S. daubrei, s.n. Trias, L. Rhine.

Jaw & teeth of Saurichthys from the Muschelkalk, Kreisgau (K. Frentzen, Jahresb. u. Mitthl. Oberrhein. geol. Verein. n.s. vol. ix. 1920, pp. 54, 55, figs. 6, 7).

S. madagascarensis sp. nov. J. Piveteau 1946 (1948) Ann. de Pal. 31 p. 82 pls. iv-v.

L. Trias. Madagascar. [Sakoa fm. Estrias & Mévo].

J.P. Lehman 1952, K.Sv. Vet. Ak. Handl. (4) 2 b, p. 113, ff. 74-76, pl. 34, 35 fig B-D, 48 fig B.

S. spp. ? S. madagascarensis J.P. Lehman et al. 1954, Ann. Paléont. 45 184, 185-7 pl. iii ff c. iv, v. See pl. vii B

S. piveteaui s.n. (? L. Trias) Madagascar L. Batau, 1958, C.R. Acad. Sci. Paris 247: 1634 ff. 1-6

Stenoprotome lamelā, g. ts. n. O. P. Hay, Bull. Am. Mus. N. H. vol. xix (1903) p. 407, pl. xxvi, f. 2; pl. xxvii, f. 2; - U. Cret; Lebanon. [Imp. fishes; A. M. N. H.]. Not Saurichthyid, E. A. Stensiö loc. cit. infra (1925) p. 175.

Saurichthys huanghanensis s. n. H. Chow & Hsia 1957, Acta pal. Sinica 5, 2: 303, pl. i. Trias. Shensi. China

See also Stichopterus woodwardi, pl. IV, p. 2.

Stichopterus woodwardi, O. M. Reis, Rech. géol. min. chemin de fer de Libérie, livr. 29 (1909), p. 15, pl. i, figs. 8-10. — Jurassic; Liberia.

Saurichthys ornatus, n.sp. E. A. Stensiö, Trias. Fish. Spitzb. pt. ii, Kungl. Sv. vet. Akad. Handl. [3], b. 2 (1925) p. 13, pls. 1-16, pl. 26 f. 2, text figs. 1-12, 14, 16-29, 36 b. — Trias; Spitsbergen. [Head etc. Imp. fishes; Geol. Mus. Univ. Uppsala].

Saurichthys elongatus, n.sp., E. A. Stensiö, loc. cit. (1925) p. 146, pls. 21-24; pl. 25, figs. 1-4; pl. 32, f. 3; pl. 34, f. 1, 3; text figs 43-47. — Ibid. [ditto]

Saurichthys hamiltoni. n.sp. E. A. Stensiö, loc. cit (1925), p. 153; pl. 26 figs. 1, 3-5; pls. 27-31; pl. 32, figs 1, 2, 4; pl. 33, 1-3; pl. 34, f. 2; text figs 48-56. — ditto Ibid [ditto].

Rhynchotus reminiscens Jaekel 1925, Paläont. Zeitschr. LV. 478. 'Stör-Typus' aus Lockansan.

ERROLICHTHYIDAE.

Errolichthys mirabilis g. ts. n. Eotrias Madagascar. J. P. Lehman 1952 K. Sv. Vet.-Ak. Handl. (4) 2, 6, p. 122 ff. 79, 80, 82 pls. 45, 46, 47 f. A. [Skull-morph. BM.]. E. Nielsen 1955, Medd. dansk. geol. Foren. 12 6, p. 563 11 figs.

L. G. de Koninck, Quart. Journ. Geol. Soc. vol. xix. (1863), p. 17, pl. viii. figs. 6, 7.

The teeth from the Muschelkalk of Jena named *Thelodus inflexus* by E. E. Schmid (*loc. cit.* 1861, p. 27, pl. iv. figs. 17–19) are also very doubtfully placed here. Nothing is known of those from Laineck recorded as *Saurichthys semistriatus*, Münster, in F. Braun, Verzeichn. Beyreuth befindl. Petrefact. (1840), p. 73.

A fragmentary fossil from the Lower Lias of Barrow-on-Soar, Leicestershire, now in the Leicester Museum, has been provisionally associated with *Belonorhynchus* and *Saurichthys*, under the name of *Browneichthys ornatus* (A. S. Woodward, Geol. Mag. [3] vol. vi. 1889, p. 455). The bones of the head are invested with ganoine and ornamented with large tuberculations. The notochord seems to have been persistent. At least the front portion of the trunk is covered with thin, deeply overlapping scales, oval or round in shape, with prominent concentric lines of growth, and externally ornamented with large ganoine tubercles. There was also a partial or continuous armature of the dorsal and ventral margins, consisting of large, narrow, pointed ridge-scales.

Family CHONDROSTEIDÆ.

Trunk elongate-fusiform; tail heterocercal. Head-bones well-developed, those of the cranial roof forming a continuous shield, without a median longitudinal series of azygous elements; snout prominent and eye far forwards; no premaxilla; dentition rudimentary or absent; operculum and suboperculum present, with a few well-developed branchiostegal rays. Squamation rudimentary or absent on the trunk, robust on the upper caudal lobe.

Only one definable genus of this family, *Chondrosteus*, has hitherto been discovered; but it seems probable that the fragmentarily-known genus *Gyrosteus* will prove to be correctly placed here.

Genus **CHONDROSTEUS**, Egerton.

[Phil. Trans. 1858, p. 871 (*ex* Agassiz, MS.).]

External bones feebly ornamented with granulations, partly coated with ganoine; mandibular suspensorium very oblique; jaws toothless; maxilla arched, much expanded behind and tapering in front, without process for palatine articulation; suboperculum large and quadrate, operculum relatively small and triangular. Ribs absent. Fin-rays covered with a very thin film of ganoine, the pectorals also sparsely granulated; all closely articulated except a few anterior pectorals, which are not enlarged; fulcra absent,

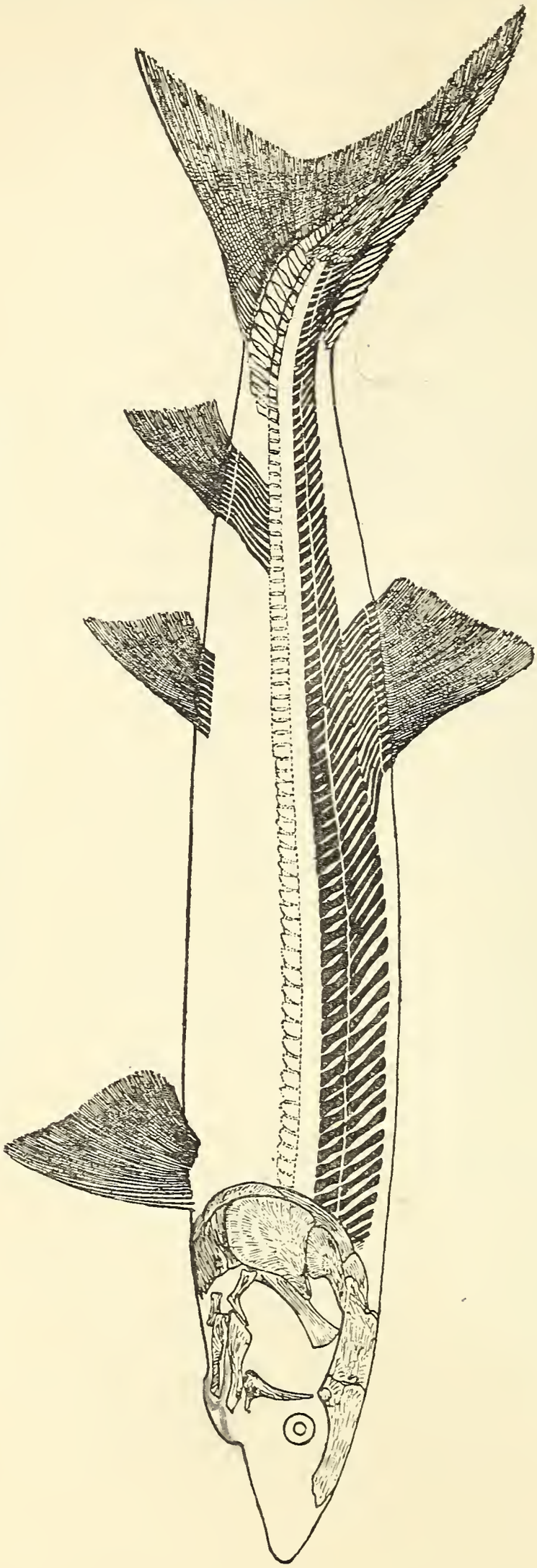


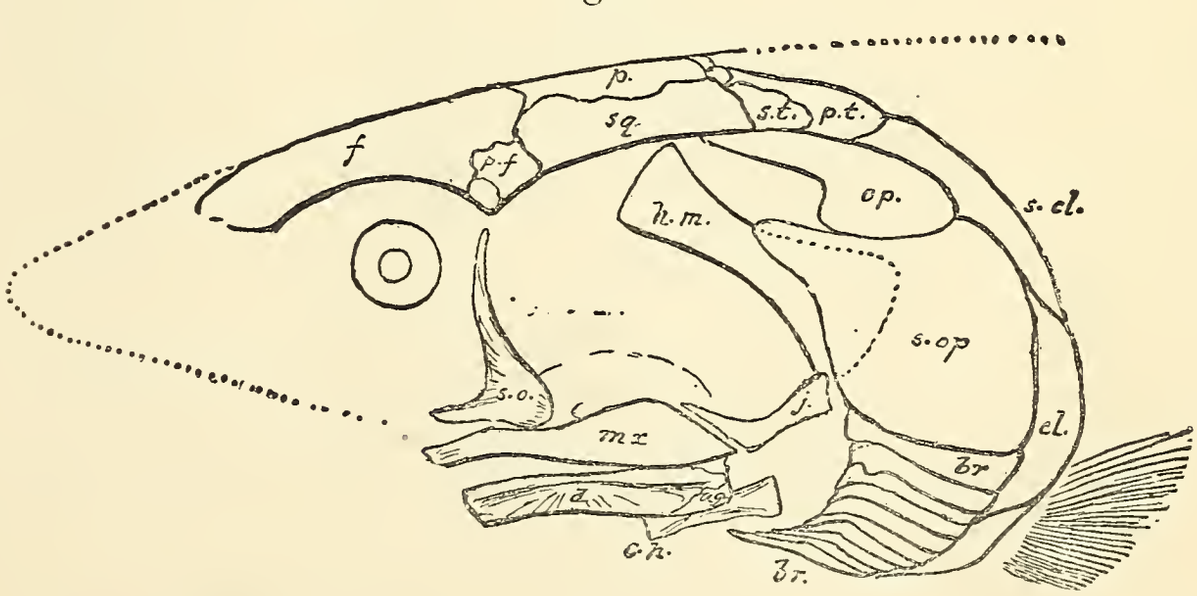
Fig. 2.

Restoration of skeleton of *Chondrosteus acipenseroides*, one-sixth nat. size.

the anterior rays of each fin gradually increasing in length to an acumination. Pelvic fins remote, the dorsal opposed to this pair; caudal fin forked, nearly equilobate. Scales absent, except on the upper caudal lobe where they are thick and rhombic, invested with ganoine; caudal fulcral scales large, with ganoine.

Nothing is known of the ossifications in the chondrocranium of *Chondrosteus*, but many specimens exhibit the chief membrane-bones. The parietals (figs. 3, 4, *p.*) are longer than broad and comparatively small; both these and the large frontals (*f.*) meeting at the middle line in a slightly wavy suture, without any interposed elements or vacuities. The squamosals (*sq.*) are larger than the parietals, extending as far forwards as the latter; the postfrontals (*p.f.*) are relatively very small. No cranial bones have been recognized in advance of the frontals, and the extent of the rostrum is thus undetermined. Cheek-plates are also almost wanting, only one suborbital (figs. 3, 5, *so.*) being observed, bearing an upward process ascending towards the postfrontal. A series of five supratemporal plates (fig. 4, *s.t.*), of which the three innermost are relatively small, occurs along the occipital border. The hyomandibular (figs. 3, 6, *hm.*) is shaped as in modern Sturgeons, but apparently ossified as far as its lower extremity; and a symplectic must have been present, although it is doubtful whether this was ossified in any part. The pterygo-quadrate arcade exhibits only two ossifications on each side, one being a large expanded

Fig. 3.



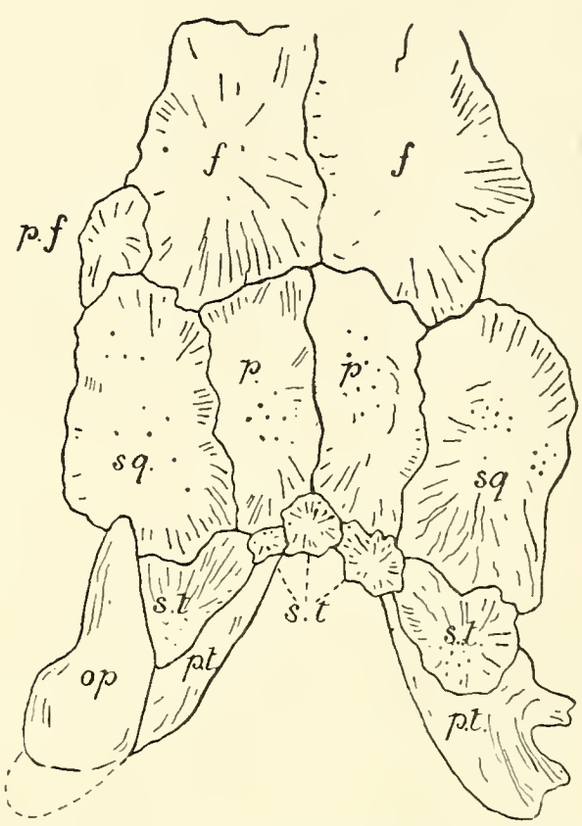
Profile of head of *Chondrosteus acipenseroides*, restored (after Traquair). *j.*, jugal. Other letters as in figs. 4, 5.

element (Pl. I. fig. 3, *pt.*) of pterygoid nature, and the other a small V-shaped bone (*pl.*) articulated with the maxilla, which may be either palatine or ectopterygoid. Sheathing the arcade is

a long curved maxilla (Pl. I. figs. 2, 3, *mx.*), deep behind and much contracted anteriorly, meeting its fellow of the opposite side in front in a distinct symphysis. Another small membrane-bone, abutting upon the postero-superior margin of the maxilla, may be regarded as the jugal (Pl. I. fig. 3, *ju.*). The mandible exhibits three bones, the dentary being much the largest, the articular and angular insignificant. The dentary is somewhat arched, the inferior margin being concave; but there is scarcely any tapering at the symphysis, and the coronoid region is not elevated. The ossified, hour-glass-shaped ceratohyal is frequently shown (Pl. I. fig. 2, *ch.*), but nothing further is known of the hyoid apparatus.

The operculum is relatively small and shaped almost like an inverted comma with the tail pointing forwards and upwards

Fig. 4.



Cranial roof of *Chondrosteus acipenseroides* (after Traquair). From specimen in Museum of Practical Geology.

f., frontal; *op.*, operculum; *p.*, parietal; *p.f.*, post-frontal; *p.t.*, post-temporal; *s.t.*, supra-temporal; *sq.*, squamosal.

(figs. 3, 4, 6, *op.*). The suboperculum (*s.op.*) is much broader and almost quadrate, with produced antero-superior angle. About ten branchiostegal rays (*br.*) can be counted, the uppermost broad and the lowermost narrower; but there are no indications of a gular plate.

The notochord must have been persistent, with no calcifications

1929. Chondrosteus acipenseroides Tf. O. Jaekel Abh.
Geol. Pal. III Hf. 27, 36, pl. XI.

in its sheath; and the peripheral arches are only imperfectly calcified. The neural arches are stout and each pedicle (Pl. I. fig. 4, *n.a.*) is separate both from its fellow of the opposite side and from the long neural spine (*n.s.*). No traces of ribs have been observed, and robust hæmal arches have only been seen at the base of the lower caudal lobe.

The pectoral arch closely resembles that of *Acipenser*. The post-temporal (figs. 3, 4, *p.t.*) is a small, narrow triangular bone, overlapped at its attenuated anterior end by the supratemporals. The long narrow supraclavicle (figs. 3, 6, *s.cl.*) is obliquely crossed near its upper extremity by the lateral line. The clavicle (Pl. I. fig. 5, *cl.*) is sharply bent, with a lower limb and an inner laminar expansion as in *Acipenser*. The infraclavicle (*i.cl.*) is relatively small and trapezoidal. The pectoral fin-supports are unsatisfactorily known. The pelvic fin-supports, so far as preserved, are a single regular series of stout, elongated cartilages, much fewer than the dermal rays; but a double series occurs both in the dorsal and anal, the baseosts being short, and the axonosts much elongated, extending almost or quite to the neural and hæmal spines of the axial skeleton.

The large fulcral scales at the base of the upper caudal lobe are supported by a distinct series of vertically elongated cartilages above the neural arches.

Chondrosteus acipenseroides, Egerton.

[Plate I. figs. 1–5.]

1844. *Chondrosteus accipenseroides,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 280 (name only).

1858. *Chondrosteus acipenseroides,* Sir P. Egerton, Phil. Trans. p. 871, pls. lxvii., lxix., pl. lxviii. fig. 2.

1858. *Chondrosteus crassior,* Sir P. Egerton, *ibid.* p. 883, pl. lxviii. fig. 1, pl. lxx. [Head; British Museum.]

1887. *Chondrosteus acipenseroides,* R. H. Traquair, Geol. Mag. [3] vol. iv. p. 248, woodc. figs. 1–5 (reprinted in Proc. Roy. Phys. Soc. Edinb. vol. ix. p. 349, with woodcuts).

1887. *Chondrosteus acipenseroides,* J. W. Davis, Quart. Journ. Geol. Soc. vol. xliii. p. 605, pl. xxiii.

1889. *Chondrosteus acipenseroides,* A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 36, woodc. figs. 8–12.

1889. *Chondrosteus acipenseroides,* M. Browne, Trans. Leicester Lit. & Phil. Soc., n. s., vol. ii. pt. i. p. 17, pls. i., ii.

Type. Imperfect fish; British Museum.

The type species, usually attaining a length not exceeding one metre. Maximum depth of trunk contained about five and a half

times in the total length from the pectoral arch to the extremity of the caudal fin. Superficial granulations of external bones sparse, rounded, and those of the pectoral fin similar. Suboperculum about as deep as broad, with produced antero-superior angle; operculum much narrower and smaller, with somewhat excavated anterior border; at least nine or ten branchiostegal rays on each side. Pelvic fins more than two-thirds as large as the pectorals, the distance between these two pairs more than twice as great as that between the former and the anal. Anal fin about equal to the pelvic fins in size; dorsal relatively large, as long as deep; caudal fin large. Caudal fulcral scales narrow and sharply pointed.

Form. & Loc. Lower Lias: Dorsetshire and Leicestershire.

All the following specimens were obtained from the neighbourhood of Lyme Regis, Dorsetshire :—

P. 3361. Imperfect trunk, wanting the hinder half of the caudal region, but with remains of the head and opercular apparatus, described and figured by Egerton, *loc. cit.* p. 872, pl. lxvii. This being the first specimen described, must be regarded as the type of the species.

Enniskillen Coll.

P. 3366. Well-preserved fish about one metre in total length, shown of one-quarter the natural size in Pl. I. fig. 1, and forming the basis of the restoration in fig. 2, p. 24. The head is obliquely crushed and very imperfect, but several elements are distinct. The exposed surface of the bones of the cranial roof is finely rugose, exhibiting a few tuberculations. Below it is the partially-covered robust hyomandibular (*hm.*); and in the region of the jaws there only remain the imperfect pterygoid (*pt.*) and jugal (*ju.*) of the right side. The small narrow operculum (*op.*) and the relatively large suboperculum (*s.op.*) are well preserved. Both post-temporals are shown, that of the left side from the inner, that of the right side from the outer aspect; and the long, narrow supraclavicle (*s.cl.*) is seen above the comparatively large clavicle (*cl.*). The axial skeleton of the trunk is only very imperfectly exhibited; but a few of the slender neural spines with their stouter arches occur scattered in the abdominal region. The specially robust hæmal arches at the base of the lower caudal lobe are also seen. All the fins are preserved, only the upper extremity of the caudal being wanting. The anterior rays in each fin gradually increase in length to its apex,

P. 3367 noticed by A. S. Woodward, Geol. Mag. [4] vol. ii (1895), p. 206.

the short foremost of these being apparently unjointed: all the rays beyond the apex are articulated and finely branched distally. The anterior pectoral rays are not much enlarged, and there are indications of the superficial tubercles on this fin. The pelvic fins appear to be slightly deeper than long, and each is supported by a regular series of short and stout hour-glass-shaped basals. The dorsal fin is opposed to the latter and is shown to have been supported by short, stout baseosts and slender, elongated axonosts, which taper towards the neural arches of the axial skeleton. The anal fin is smaller than the dorsal, and its endoskeletal supports are only feebly indicated. A series of supports, slender anteriorly, becoming shorter and robust behind, is displayed beneath the fulcral scales of the upper caudal lobe; seven scales resting upon ten or eleven supports. The caudal fin is nearly equilobate. The oat-shaped scales are well-preserved on the sides of the upper caudal lobe, smooth and flattened externally, tumid on their attached face. There is no evidence of other dermal armature; but fragments apparently of the skin are preserved in the upper half of the abdominal region, and these exhibit a series of short double ridges evidently indicating the course of the lateral line. Some coprolitic matter occurs above the pelvic fins. *Enniskillen Coll.*

P. 2047. Imperfect small individual, originally about 0·42 in length. *Egerton Coll.*

38545. Imperfect small individual, about 0·56 in length, showing portions of all the fins. *Purchased*, 1864.

P. 3367. Slightly larger specimen, with imperfectly preserved tail, wanting the anal fin. The maxillary and pterygoid bones are described and figured by Traquair, *loc. cit.* p. 254, fig. 4, and re-drawn of the natural size in Pl. I. fig. 3 of the present volume. The left operculum and suboperculum are also shown, and the pectoral fins are especially well-preserved; most of the rays of these fins exhibit a longitudinal series of tubercles fused with their basal half. *Enniskillen Coll.*

P. 2050. Remains of head and abdominal region, exhibiting the form of the clavicle, and displaying a long series of neural arches with their loosely apposed neural spines. A

few of these arches are shown of the natural size in Pl. I. fig. 4. *Egerton Coll.*

P. 3362. Imperfect head, pectoral arch with fins, and some of the anterior vertebral arches, described and figured by Egerton, *loc. cit.* p. 873, pl. lxix. The portion of axial skeleton behind the head is not accurately drawn, there being only a single series of long slender spines loosely apposed to their more robust neural arches. As remarked by Traquair, the maxilla is interpreted by Egerton as mandible (numbered 32), the palatine (or ectopterygoid) as maxilla (21), the suborbital as premaxilla (22), and the jugal as coalesced mesotympanic and hypotympanic (28*d*). *Enniskillen Coll.*

Fig. 5.

Head of *Chondrosteus acipenseroides*, seen obliquely from below (after Traquair). [No. P. 2048.]

Lettering of figs. 5 and 6:—

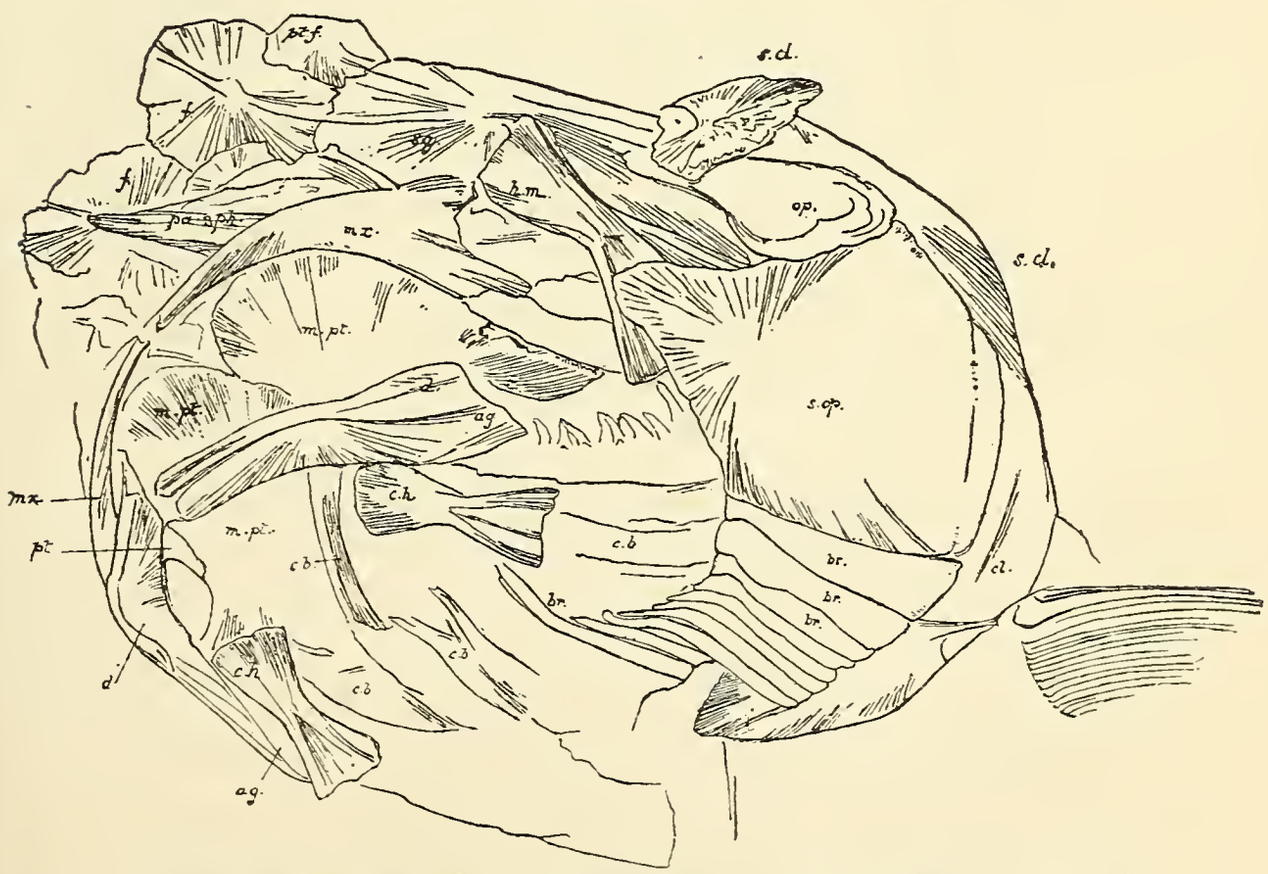
ag., angular; *br.*, branchiostegal rays; *cb.*, cerato-branchial; *c.h.*, cerato-hyal; *cl.*, clavicle; *d.*, dentary; *f.*, frontal; *hm.*, hyomandibular; *m.pt.*, mesopterygoid; *mx.*, maxilla; *op.*, operculum; *pa.sph.*, parasphenoid; *pt.*, palatine; *pt.f.*, post-frontal; *s.cl.*, supraclavicle; *s.o.*, suborbital; *s.op.*, suboperculum; *sq.*, squamosal.

P. 616. Type specimen of *Chondrosteus crassior*, Egerton, figured *loc. cit.* pl. lxviii., displaying vertically crushed remains of the head, pectoral arch, and pectoral fins. The cranial roof-bones and the outer face of the clavicle ("scapulo-coracoid") exhibit few coarse tuberculations, apparently not coated with ganoine; the pectoral fin-rays show few traces of nodose granulations. The clavicle has a distinct inferior limb, and, so far as preserved, resembles in shape that of *Acipenser*. *Egerton Coll.*

P. 2048. Head and pectoral arch, with fins, inferior aspect, described and figured by R. H. Traquair, *loc. cit.* p. 252, fig. 3. The outline-illustration is copied, of one-half the natural size, in the accompanying fig. 5, and an actual drawing of the fossil is given in Pl. I. fig. 2. The only modification in Dr. Traquair's interpretation occurs in the pectoral arch, where an accidental fracture (*x*) on each side led to the erroneous determination of the inferior limb of the clavicle as infraclavicle in the original description. The true infraclavicle (*i.cl.*) is well shown in the lithographed figure. *Egerton Coll.*

P. 2049. Head with opercular apparatus, pectoral arch and portions of the pectoral fins, lateral and partly inferior aspect,

Fig. 6.



Head and pectoral arch of *Chondrosteus acipenseroides*, lateral and partly inferior aspect (after Traquair). [No. P. 2049.]
For explanation of lettering see opposite page.

described and figured by R. H. Traquair, *loc. cit.* p. 251, fig. 2. The outline-illustration is copied, of slightly more than one-half the natural size, in the accompanying fig. 6, and explained by the lettering. The transverse cleft in the pectoral arch, though appearing as if a suture and interpreted as such by Traquair, is proved by other specimens to be accidental; the clavicle thus exhibits a large inferior limb. *Egerton Coll.*

P. 7396. Head and opercular apparatus, exposed from the left side, the aspect being partly lateral and partly ventral. Many of the bones are well exhibited, and an elongated element between the inferior extremity of the hyomandibular and the quadrate region is especially noteworthy; this may be an ossified symplectic, as remarked by Traquair, *loc. cit.* p. 250. *Purchased.*

P. 3363–4, P. 3370. Three examples of the head and pectoral arch, with remains of the pectoral fins, the first shown from the dorsal aspect, the others from the lateral aspect. The clavicle in each exhibits a large inferior limb and an extensive inner laminar expansion; and the second fossil also seems to show, from its external ornamented aspect, the small infraclavicle. *Enniskillen Coll.*

P. 3369, P. 3869 a, P. 4341. Three small slabs of Lias with fragmentary remains of the head and pectoral arch. The first and third specimens exhibit, among other bones, the maxilla, palatine (or ectopterygoid), suborbital, and hyomandibular; the second specimen displays the clavicle and supraclavicle. *Enniskillen Coll.*

P. 2261 a–c. Three fragmentary small examples of the head and pectoral arch, the first displaying the operculum, among other bones. *Egerton Coll.*

P. 2261 d. Small head and right pectoral fin. The maxilla, jugal, palatine (ectopterygoid), and inner pterygoid are well displayed. *Egerton Coll.*

39494. Remains of small head and pectoral fins. *Purchased*, 1865.

P. 4341 a. Remains of pectoral arch and fins. *Enniskillen Coll.*

P. 4341 b. Remains of opercular apparatus and pectoral arch of a small fish, displaying both clavicles from the visceral aspect, and the infraclavicle from the same aspect on the

1929. C. P. O. Jaekel, Mon. Geol. Pal. (N.S.) III, p. 98, pl. xii.

right side. The right clavicle and infraclavicle are shown, of the natural size, in Pl. I. fig. 5. The clavicle (*cl.*) is precisely similar to that of *Acipenser* (fig. 15, p. 40) in shape, but the infraclavicle (*i.cl.*) is relatively smaller than the corresponding element of the recent genus.

Enniskillen Coll.

35056. Trunk about 0·51 in length, wanting the pelvic fins. The anal fin is displaced, but exhibits both the series of basal cartilages. *Purchased*, 1860.

P. 3371 a. Caudal region of a medium-sized fish, with the median fins somewhat crushed and broken and remains of the pelvic pair. Some of the neural spines of the axial skeleton are exhibited beneath the supports of the dorsal fin: and each seen in front view shows a bifurcation of its lower extremity. There are no distinct traces of hæmal arches except at the base of the caudal fin.

Enniskillen Coll.

P. 3365. Very small imperfect caudal region, showing the pelvic, anal, and caudal fins. *Enniskillen Coll.*

P. 3365 a. Dorsal and pelvic fins of a small fish. *Enniskillen Coll.*

P. 7397. Caudal fin of moderate size. *Purchased.*

P. 3365 b. Another specimen, wanting the extremity of the upper caudal lobe. *Enniskillen Coll.*

39495. Caudal fin 0·28 in depth, displaying the caudal fulcral scales, one figured in Proc. Geol. Assoc. vol. xi. pl. i. fig. 7. *Purchased*, 1865.

P. 3368. Two examples of the caudal fin, slightly smaller.

Enniskillen Coll.

Chondrosteus pachyurus, Egerton.

1858. *Chondrosteus pachyurus*, Sir P. Egerton, Phil. Trans. p. 883.

Type. Tail; Museum of Practical Geology, London.

The undermentioned specimens indicate a fish about twice as large as the ordinary *C. acipenseroides*, which is regarded by Egerton as specifically distinct from the latter. So far as known, the cranial roof-bones are ornamented with closely-arranged fine tuberculations; and the caudal fulcral scales appear to be relatively broader than those of the type species, though also acuminate.

Form. & Loc. Lower Lias: Dorsetshire.

P. 7398. Plaster cast of tail, the original being the type specimen described by Egerton, *loc. cit.*; Lyme Regis. This is supposed to belong to the same individual as one of the following specimens.

28714. Crushed remains of head and pectoral arch, with a few fragmentary neural arches of the trunk and some well-preserved pectoral fin-rays, noticed by Egerton, *loc. cit.*, and by the present writer in Proc. Geol. Assoc. vol. xi. (1889), p. 36; Lyme Regis. The tuberculations on the pectoral fin-rays are shown. *Purchased*, 1853.

28714 a. Slab exhibiting the external tuberculated surface of three of the cranial roof-bones and other fragments, with an imperfect clavicle, described by Egerton, *loc. cit.*; Lyme Regis. The two principal cranial bones are described as mastoids (*i. e.*, squamosals), and the clavicle appears to be referred to as "suprascapula." *Purchased*, 1853.

Genus **GYROSTEUS**, A. S. Woodward.

[Proc. Geol. Assoc. vol. xi. 1889, p. 36 (*ex* Agassiz, MS.).]

An imperfectly definable genus comprising fishes of large size, hitherto known only by fragmentary specimens. External bones with or without a feeble ornamentation, destitute of ganoine; jaws toothless; maxilla arched, not much expanded behind, but with a great upward and inward extension in its anterior half for palatine-pterygoid articulation; hyomandibular completely ossified; sub-operculum (?) large and quadrate. Small ossified ribs present (?). Scales absent, except on the upper caudal lobe, where they are thick; caudal fulcral scales large, without ganoine.

Gyrosteus mirabilis, Agassiz, MS.

1844. *Gyrosteus mirabilis*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 179 (name only).

1855. *Sepia incomposita*, M. Simpson, Foss. Yorkshire Lias, p. 21. [Fragment of bone; Whitby Museum.]

1858. *Gyrosteus mirabilis*, Sir P. Egerton, Phil. Trans. p. 883.

1876. *Gyrosteus mirabilis*, J. F. Blake, in Tate & Blake, Yorkshire Lias, p. 256, pl. ii. figs. 2, 3.

1889–90. *Gyrosteus mirabilis*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 32, figs. 2–7; and The Naturalist, 1890, p. 101, figs. 1–6.

n.g.
Strongylosteus Lindenbergi, Jaekel?
Chondrosteus lindenbergi, J. F. Pompeckj,

B. Hauff, Palaeontogr. vol. lxiv (1921), p. 32 (name only). — U. Lias; Holzmaden. [Tübingen Mus.]
E. Hennig, Geologie von Württemberg (1923), pl. vii b. 4° B. Hauff 1552 Holzmadenbuch p. 22 pls 38, 39.

1835. Gyrostris mirabilis, L. Agassiz, Proc. Geol. Soc. vol. ii. p. 208 (name only).

1898. Gyrosteus mirabilis, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii. p. 461, pl. lxviii, lxix, text-figs. 2–12.
1929. G. m. Ojaekel, Mon. Geol. Pal. iii text-figs 28, 49, pl. xiv, fig. A.

36185. Des: & fig: Ann. nat. hist. 1898, p. 462, pl. lxviii. fig. 1.

Type. Various bones; British Museum.

The type species, of large size, probably attaining a length of not less than six or seven metres. Most of the external head-bones apparently ornamented with large, well-spaced tubercles, those on the suboperculum (?) tending to an arrangement in radiating lines. Maxilla smooth, its length somewhat more than twice as great as its maximum depth at the anterior expansion; the supposed suboperculum as broad as deep, with excavated anterior border. Caudal fulcral scales smooth, or only in part faintly rugose.

Form. & Loc. Upper Lias: Yorkshire.

The following specimens were all obtained from the cliffs in the neighbourhood of Whitby.

36185. A large slab displaying numerous bones, among which may be recognized the hyomandibular, ceratohyal, supposed suboperculum, clavicle, supraclavicle, fragments of squamous tuberculated bone, and portions of fin-rays. The bone interpreted as suboperculum closely resembles that element in *Chondrosteus*, but is not coated with ganoine, being covered with coarse tuberculations, of which a few are arranged along the radiating lines of growth.

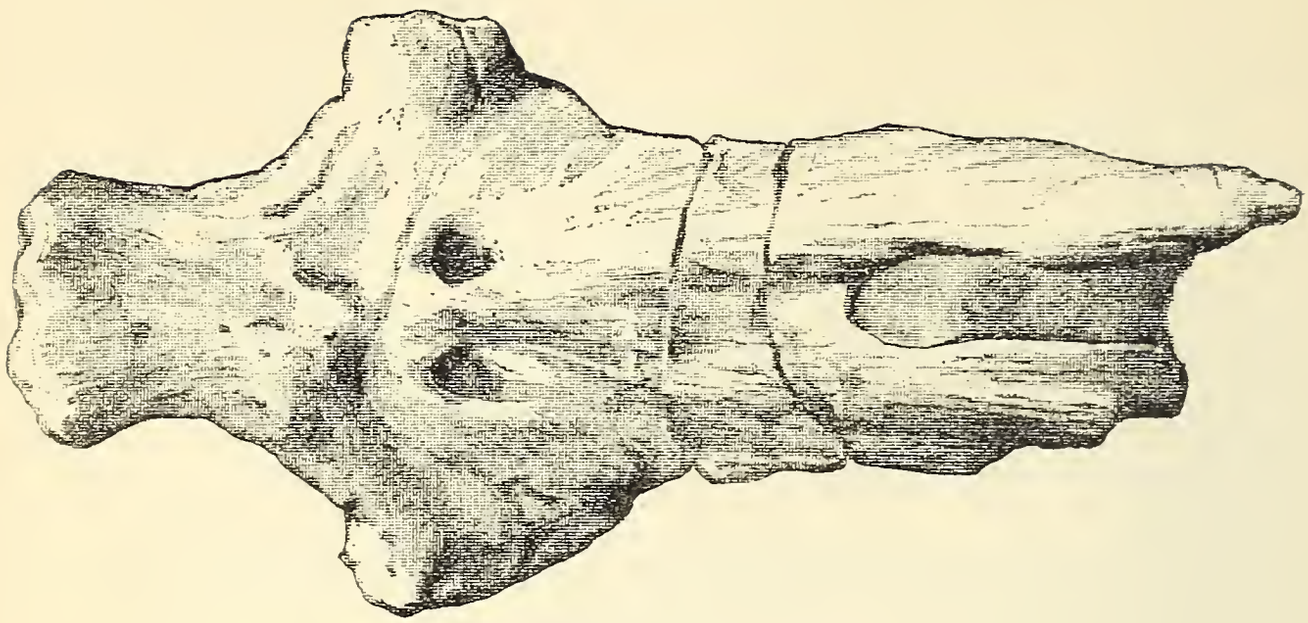
Purchased, 1861.

P. 3356 d–f. Three small slabs exhibiting various bones in a more or less fragmentary state. The left clavicle, probably belonging to the first slab, is shown from the outer aspect, of one-sixth the natural size, in fig. 14 (p. 40), and is described and figured by the present writer in Proc. Geol. Assoc. vol. xi. pp. 34, 35, fig. 4. The second slab includes part of a spatulate bone, with remains of an external tubercular ornament. The third slab exhibits the bones in a remarkably friable and crushed condition, partly pyritised, and comprises both supraclavicles, some fin-rays, and part of a hyomandibular.

Enniskillen Coll.

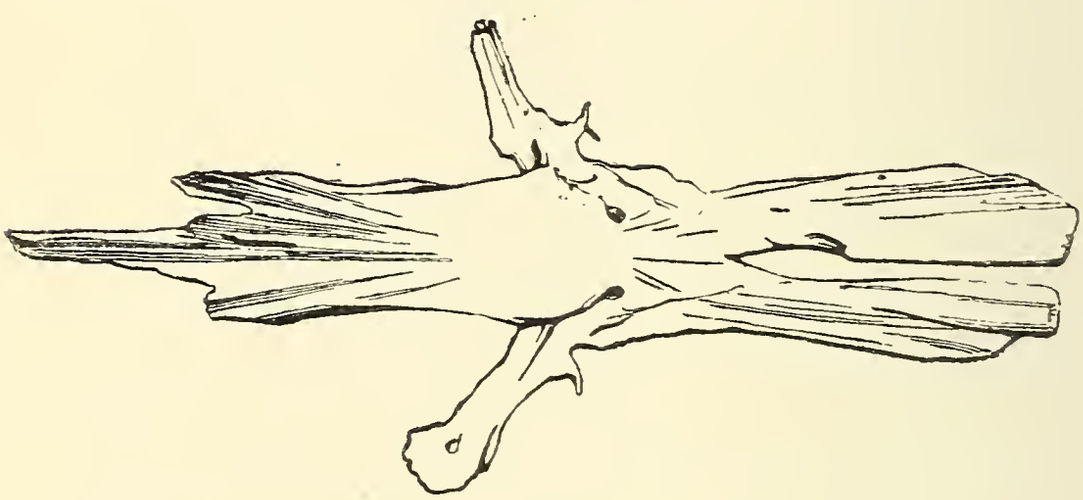
P. 2262 a, b. Two examples of the parasphenoid bone, the first most nearly complete and shown of one-quarter the natural size, from the inferior aspect, in fig. 7. The general form of the element is much like that of the modern *Acipenser* (fig. 8), but the expansion at the origin of the basipterygoid processes is wider. *Egerton Coll.*

Fig. 7.



Parasphenoid of *Gyrosteus mirabilis*, inferior aspect, one-fourth nat. size. [No. P. 2262 *a*.]

Fig. 8.



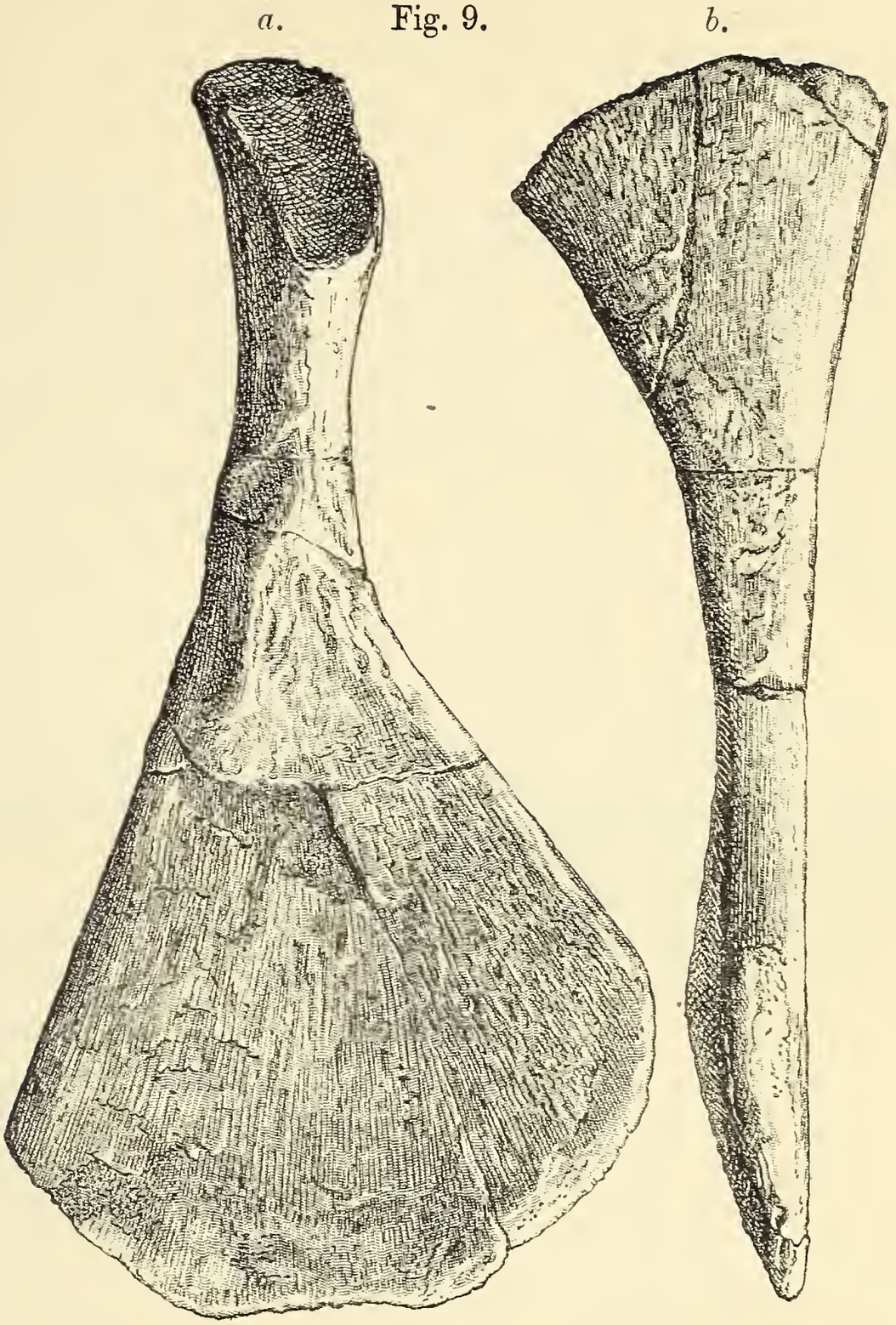
Parasphenoid of the recent *Acipenser*, inferior aspect.

P. 3356 g. More imperfect parasphenoid associated with other fragments. *Enniskillen Coll.*

P. 3356 a, h. Two examples of the hyomandibular, ossified apparently as far as the distal border, the first shown of one-third the natural size, from the lateral and posterior aspects, in fig. 9; described and figured *loc. cit.* pp. 32, 33, fig. 2. *Enniskillen Coll.*

P. 3356 k. Hyomandibular probably of young, wanting the ossification of the expanded extremities. *Enniskillen Coll.*

Fig. 9.



Right hyomandibular of *Gyrosteus mirabilis*, lateral aspect (*a*), and posterior aspect (*b*), one-third nat. size. [No. P. 3356 *a*.]

P. 3356 l. Left maxilla, shown of one-quarter the natural size from the outer, anterior, and inferior aspects in fig. 10. It differs from the corresponding bone of the recent *Acipenser* (fig. 11) in the relatively greater steepness of the anterior border, and in the straightness, shortness, and posterior expansion of the hinder half of the element.

Fig. 10, *a*.

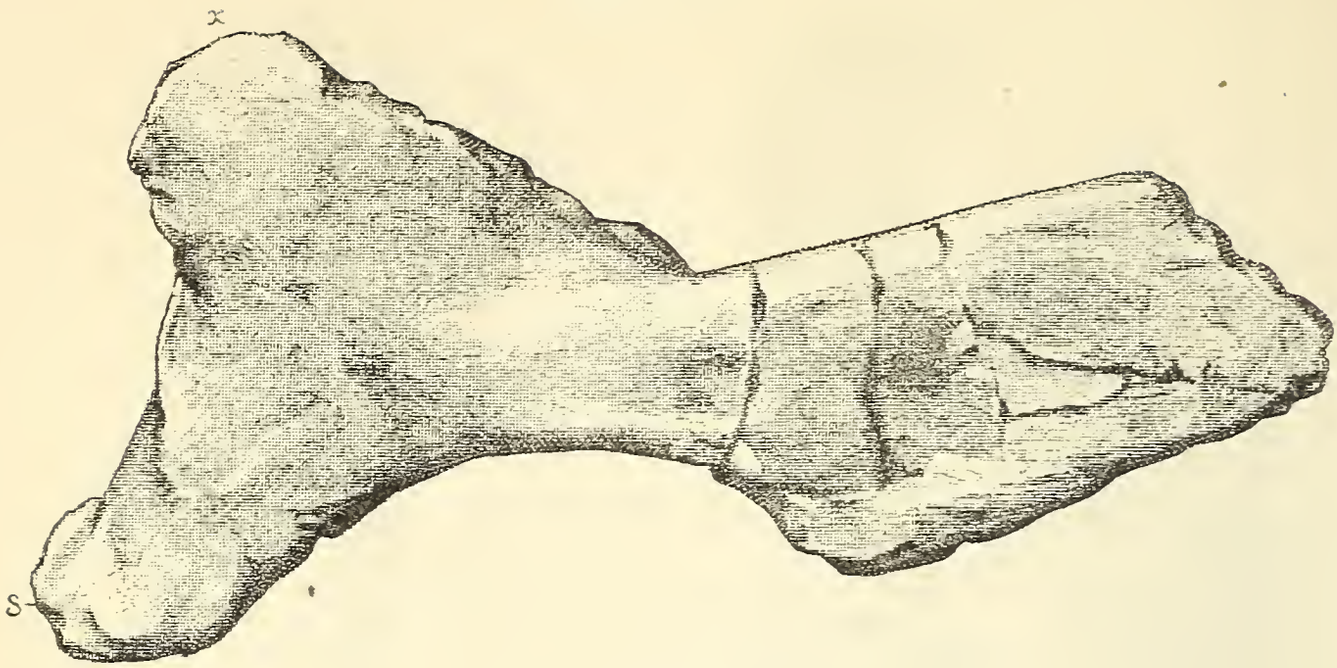


Fig. 10, *c*.

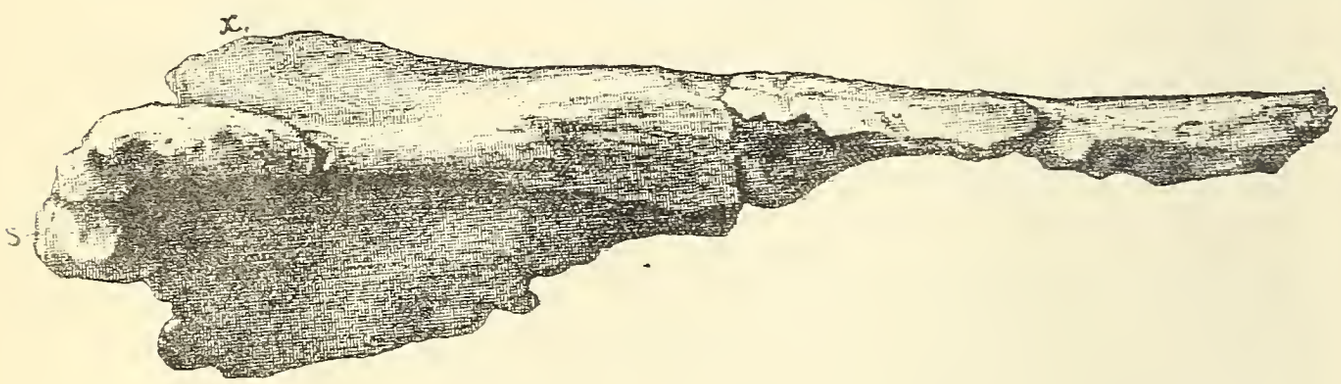


Fig. 10, *b*.

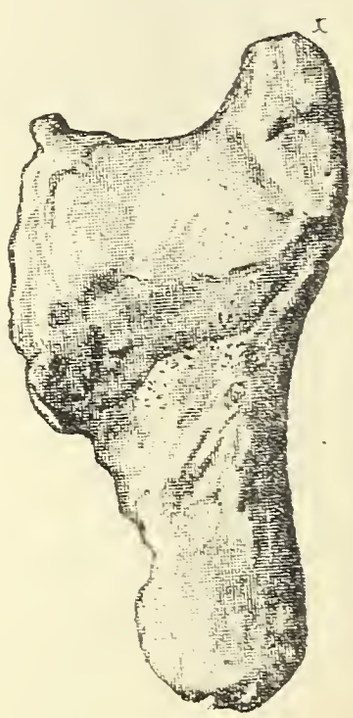


Fig. 11.

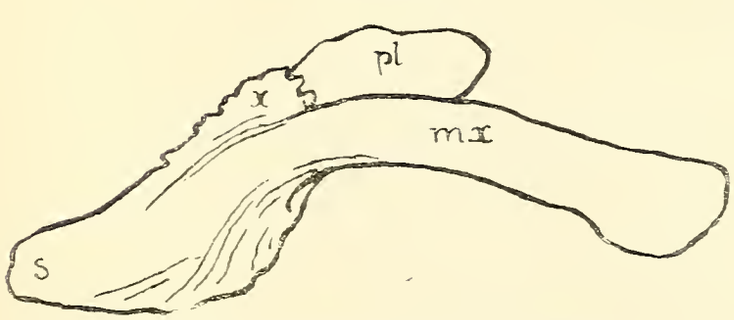


Fig. 11.—Left maxilla (*mx.*) and palatine (*pl.*) of the recent *Acipenser*, outer aspect.

Fig. 10.—Left maxilla of *Gyrosteus mirabilis*, outer (*a*), anterior (*b*), and inferior (*c*) aspects, one-quarter nat. size. [No. P. 3356 *l*.]
s., symphysial extremity; *x*., palatine process.

Viewed from the front and below, it appears as if the palatine bone were fused with the maxilla, as sometimes occurs in *Acipenser*. *Enniskillen Coll.*

43304. Ceratohyal, shown of one-third the natural size in fig. 13, described and figured *loc. cit.* pp. 33, 35, fig. 3.
Purchased, 1871.

P. 2262 c. Finer example of the same bone, labelled "*Gyrosteus mirabilis*, Ag." by Agassiz, shown of one-third the natural size in fig. 12, described and figured, *ibid.*
Egerton Coll.

Fig. 12.

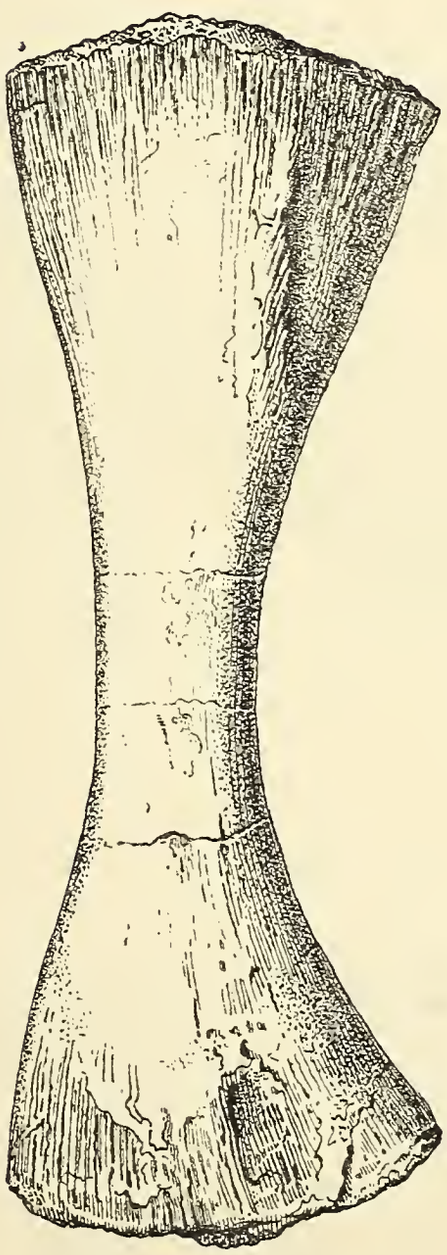
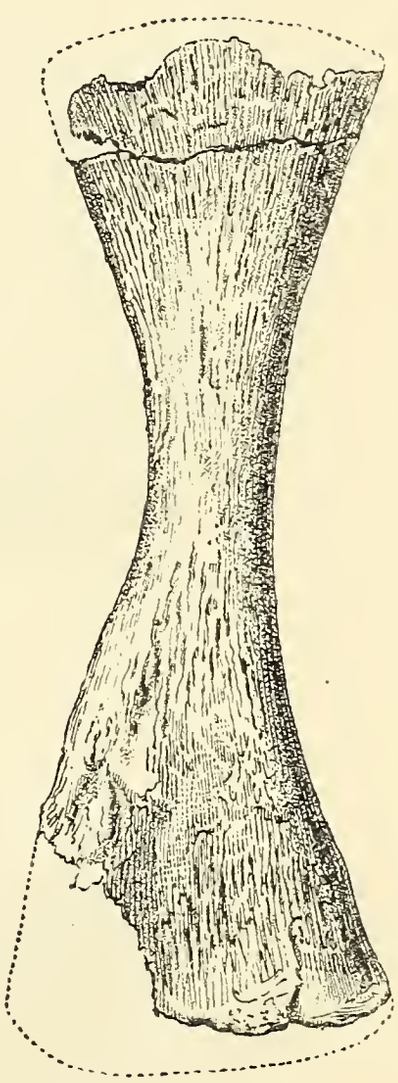


Fig. 13.



Ceratohyals of *Gyrosteus mirabilis*, one-third nat. size.
[Nos. P. 2262 *c*, 43304.]

Fig. 14.

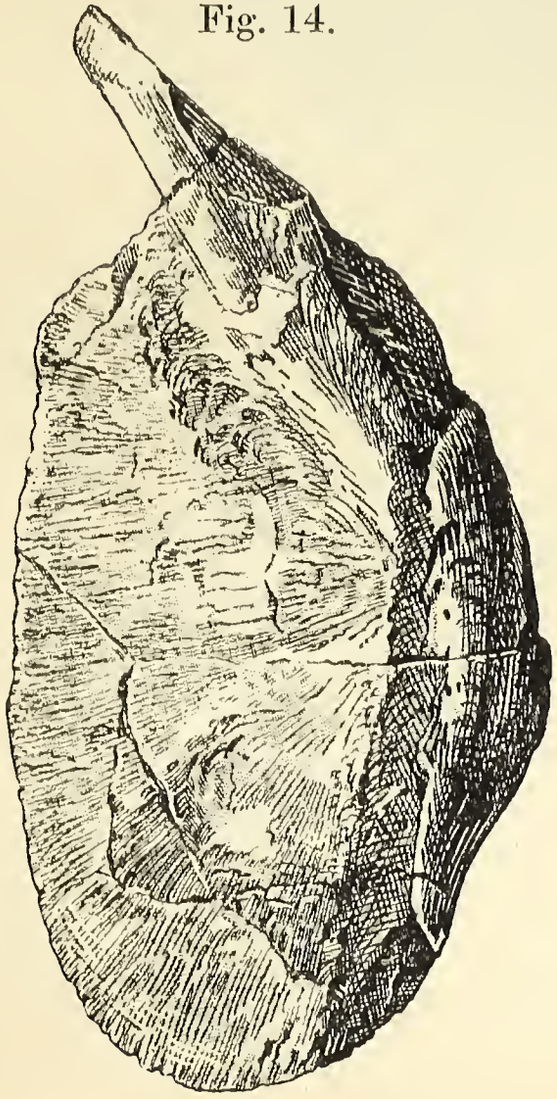


Fig. 15.

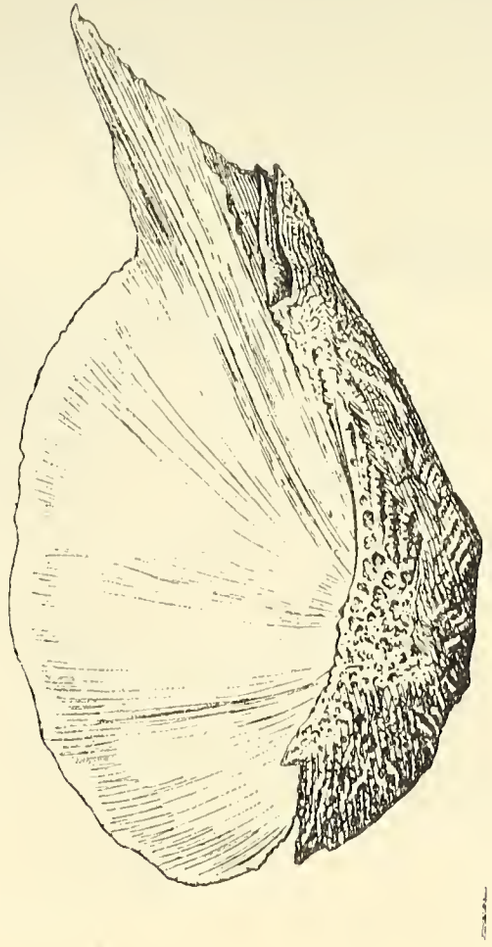


Fig. 16.

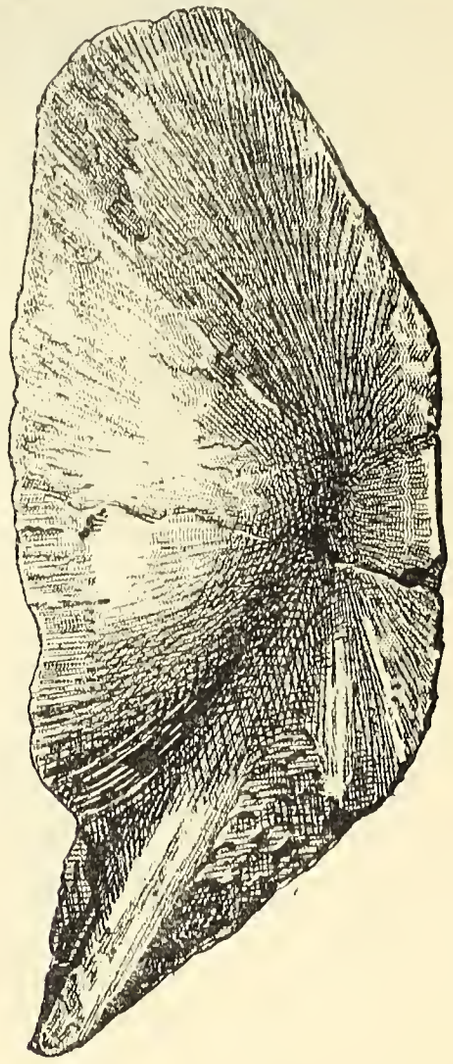


Fig. 14.—Left clavicle of *Gyrosteus mirabilis*, outer aspect; one-sixth nat. size. [No. P. 3356 *d*.]
Fig. 15.—Left clavicle of the recent *Acipenser*, outer aspect; reduced.
Fig. 16.—Right supraclavicle of *Gyrosteus mirabilis*, inner aspect; one-sixth nat. size. [No. P. 3356 *b*.]

P.3356m. True vertebral arches des? & fig? Lon. ich.
1898, p. 468, pl. Ixviii. fig. 2.

P. 3356 m. Series of vertebral arches, each with a posterior expansion at the base and a truncated distal end which seems to have been originally invested with cartilage. The fossil probably represents the hæmal arches of *Gyrosteus mirabilis* in the region of the caudal fin.

Enniskillen Coll.

P. 3356 b. Right supraclavicle, shown of one-sixth the natural size, from the inner aspect, in fig. 16, figured *loc. cit.* p. 34, fig. 6. *Enniskillen Coll.*

P. 3356 c. Portion of caudal fin displayed in irregular section, shown of one-third the natural size in fig. 17, described and figured *loc. cit.* pp. 35, 36, fig. 7. The stout, closely-articulated and distally-bifurcating rays are well exhibited. *Enniskillen Coll.*

Fig. 17.

Caudal fin-rays of *Gyrosteus mirabilis*; one-third nat. size. [No. P. 3356 *c*.]

P. 2262 e, P. 3358. Polished sections of similar rays; from Sandsend, near Whitby. *Egerton & Enniskillen Colls.*

P. 3356 n. Series of unjointed rays, the longest piece preserved 0·5 in length, probably forming the anterior part of the pectoral fin. The foremost rays gradually increase in length, terminating successively on the anterior border; and the two parallel rods of which each is composed are fused together at the pointed distal end.
Enniskillen Coll.

Several more imperfect bones of *Gyrosteus mirabilis* from the Enniskillen Collection are also registered under the general number **P. 3356.**

All the typical examples of *Gyrosteus* are contained in an indurated matrix *; but evidence of a smaller Chondrostean, very probably of the same genus, is also found in a soft shale in the Whitby cliffs. The following are a few specimens:—

P. 3357. Hyomandibular 0·18 in length. *Enniskillen Coll.*

P. 3356 o. Crushed right clavicle, inner aspect, about 0·1 in depth.
Enniskillen Coll.

P. 2262 d. Left supraclavicle, inner aspect, nearly 0·3 in maximum depth, differing from that of *G. mirabilis* in being comparatively narrow. *Egerton Coll.*

P. 3356 p. Undetermined bone. *Enniskillen Coll.*

Family ACIPENSERIDÆ.

Trunk elongate or elongate-fusiform; tail heterocercal. External head-bones well developed, those of the cranial roof forming a continuous shield, which comprises a median longitudinal series of azygous elements; snout prominent and eye far forwards; mouth small, inferior, and suctorial, without teeth in the adult; no premaxilla; operculum present, but no branchiostegal rays. Squamation of trunk comprising few longitudinal series of overlapping bony scutes, with irregular intermediate small stellate ossifications; the lateral rhombic scales and large fulcral scales on the upper caudal lobe robust.

* This was probably obtained from the bed immediately above the Jet Rock (M. Simpson, Foss. Yorkshire Lias, ed. 2, 1884, p. xiii).

Psilichthys selwyni, T. S. Hall, Proc. Roy. Soc. Victoria, n. s. vol. xii (1900), p. 147, pl. xiv. fig. 1. — Mesozoic; Carrapook (Muntham), co. Dundas, W. Victoria. [Imperfect trunk; J. S. McPherson Coll.] T. of *Psilichthys*, Hall. See also vol ii. of this Cat. p. 526.

Protoscaphirhynchus gen. nov. type *P. squamosus* sp. nov. U. Cret. Montana, N. J. Wilimovsky 1956, J. Paleont. 30 p. 1205 f. fig. pl. 132. Tair. Univ. Michigan.

Asp. Pliocene, W. Siberia, Shtuml'ko 1934, p. 83, pl. i fig.
" " Rumania, Simionescu 1930, p. 48. fig. 77.

1931. Acipenser tobiaficus, E. I. Obik, Vert. Faunas Kyzyl. Eocene I p. 75, figs. 117–120.

Genus **ACIPENSER,** Linnæus.

[Syst. Nat. ed. 10, 1758, p. 237.]

External bones ornamented with tuberculations of ganoine. Jaws delicate, and minute pointed teeth present only in very young individuals; spiracles present. A few slender ribs. Pectoral fins with a robust anterior ray or spine; pelvic, dorsal, and anal fins remote, the two latter opposed; caudal fin inequilobate, extending to the extremity of the upper caudal lobe. Dermal scutes in five distinct series, one dorsal, two pairs lateral, not completely enveloping the caudal pedicle.

Numerous scutes, pectoral spines, and fragments of bone indistinguishable from the corresponding parts of the existing *Acipenser*, are known from Tertiary formations; but no examples sufficing for specific diagnosis have hitherto been discovered. A brief enumeration of the known fossils is given below.

Acipenser toliapicus, Agassiz, MS.

1844. *Acipenser toliapicus,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 280 (name only).

1889. *Acipenser toliapicus,* A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 28, pl. i. fig. 1.

Type. Imperfect scutes; British Museum.

A provisional name given to the earliest known scutes of *Acipenser* from the London Clay. The external surface is very deeply pitted, and the reticulations are nodose.

Form. & Loc. Lower Eocene (London Clay): Isle of Sheppey.

P. 3372. Two dorsal scutes intended by Agassiz to be the type specimens of the species, one labelled by that author, the other described and figured by the present writer, *loc. cit.* *Enniskillen Coll.*

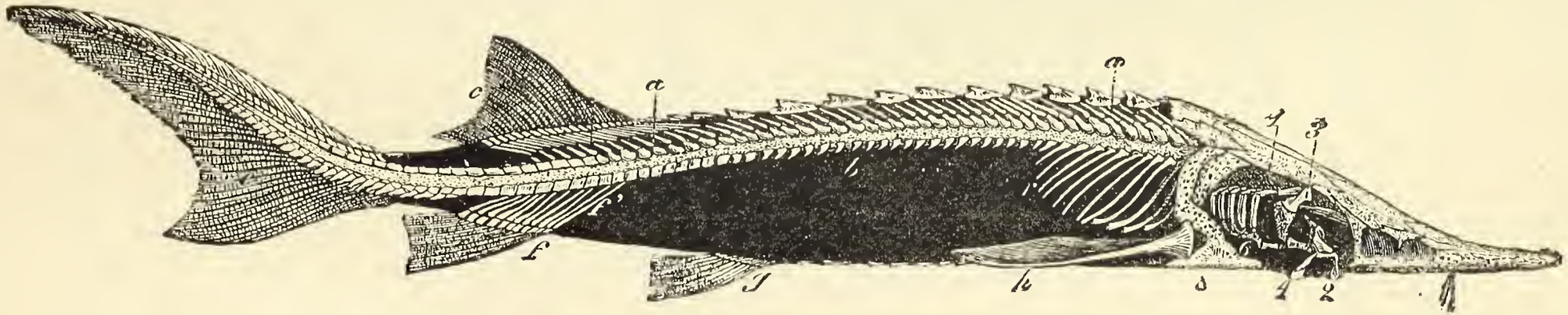
P. 529. Somewhat larger scute, labelled by Egerton as a type specimen. *Egerton Coll.*

37762. Well-preserved portion of another scute. *Purchased*, 1863.

24619. Imperfect left infraclavicle exhibiting very deep pits between the reticulations on the exposed outer face. *Purchased*, 1850.

44093. A less imperfect, larger example of the right infraclavicle 0·115 in length, showing the smooth inferior margin. Both in this and the previous specimen the external

Fig. 18.



Skeleton of Sturgeon (*Acipenser*).

1, posterior extremity of cartilaginous cranium beneath the head-plates; 2, upper jaw; 3, hyomandibular bone; 4, lower jaw; 6, gill-arches; 8, pectoral arch; *a*, neural arches and spines, placed above the notochord; *b*, hæmal arches, placed below the notochord; *c*, dorsal fin; *e*, caudal fin; *f*, anal fin; *g*, pair of pelvic fins; *h*, pair of pectoral fins; *r*, ribs.

Acipenser parisiensis, Priem.

1908. Acipenser parisiensis, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont.), p. 132, pl. iii. fig. 1, pl. iv. figs. 1–4.

Form. & Loc. Oligocene: Paris Basin.

Acipenser albertensis, Lamb.

1902. Acipenser albertensis, L. M. Lambe, Contrib. Canadian Paleont. vol. iii. pt. ii. p. 29, pl. xxi. fig. 9.

1905. J. B. in Th. Stanton & Hatcher 1905 Geol. Pal. and Bull. U.S. Geol. Surv. 257 (91-174).

Type. Dermal scute; Victoria Museum, Ottawa.

For. & Loc. Upper Cretaceous (Belly River Series): Red Deer River, Alberta.

?1905. Two pectoral fin-rays; Red Deer River. W. E. Cutler Coll.

Acipenser lemoinei, F. Priem, Bull. Soc. Géol. France [4] vol. iv (1904), p. 47; M. Leriche, Mém. Soc. Géol. Nord, vol. v (1906), p. 346.

Arius? lemoinei, F. Priem, Bull. Soc. Géol. France [4] vol. i (1901), p. 492, pl. xi. f. 9, 10 (?f. 11). — Ypresian; Epernay (Marne), France. [Pectoral fin-spine;

ornament has the appearance of not overlapping the superior margin; and there is a feeble superficial ridge extending downwards and backwards from the flexure of the bone, as in the existing species of *Acipenser*.

Purchased, 1873.

The following remains indistinguishable from *Acipenser* are also preserved in the Collection:—

P. 5283. Fine lateral scute, noticed and figured in Proc. Geol. Assoc. vol. xi. 1889, p. 28, pl. i. fig. 2; Lower Hempstead Beds, Hempstead, Isle of Wight.

Presented by the Royal Society, 1887.

P. 6475. Two portions of scutes and another fragment; probably from the Hempstead Beds. *Beckles Coll.*

41892. Two portions of pectoral spines; Upper Eocene, Hordwell, Hampshire. *Purchased*, 1870.

P. 1533, P. 1533 a. Two imperfect pectoral spines and rolled fragments of two others, part of the ornament of one figured, *loc. cit.* pl. i. fig. 3 *b*; probably from the Hempstead Beds. *Egerton Coll.*

P. 4946. Pectoral spine wanting distal extremity, resembling the York specimen figured, *loc. cit.* pl. i. figs. 3, 3 *a*; Hempstead Beds. *Presented by John Edward Lee, Esq.*, 1885.

The following remains indistinguishable from *Acipenser* have also been described:—

Acipenser ornatus, J. Leidy, Proc. Acad. Nat. Sci. Philad. 1873, p. 15, and Extinct Vert. West. Territ. (Rep. U.S. Geol. Surv. Territ.), vol. i. pt. i. 1873, p. 350, pl. xxxii. fig. 58.—Miocene; Virginia. [Scute.]

Acipenser sp., E. T. Newton, Vert. Forest Bed (Mem. Geol. Surv. 1882), p. 129, pl. xix. fig. 6; and Vert. Pliocene Dep. Britain (*ibid.* 1891), p. 100.—Forest Bed Series; Norfolk. [Cephalic plate; Museum of Practical Geology, London.]

Acipenser sp., A. S. Woodward, Proc. Geol. Assoc. vol. xi. (1889), p. 28; *Premier rayon de la dorsale d'un Poisson, ayant quelque rapport avec celui des Balistes*, P. Gervais, Zool. et Pal. Franç. (1852), Explic. Planches, Poiss. Foss. p. 5, pl. lxviii. fig. 33.—Lower Pliocene; Montpellier, France. [Pectoral fin-spine.]

Acipenser sp., A. S. Woodward, *loc. cit.* p. 29.—Red Crag; Suffolk. [Pectoral spines; York Museum.]

The dermal tubercles named *Acipenser tuberculosus* and *A. molassicus* by Probst are Selachian armour (see Part I. p. 89); and the so-called *Acipenser cretaceus* (A. Daimeries, Bull. Soc. Roy. Malacol. Belg. vol. xxvii. 1892, p. xvi) from the Senonian of Folx-les-Caves, Belgium, seems to be founded on the dermal plates of some fish related to *Dercetis* or *Eurypholis*.

Family POLYODONTIDÆ.

Trunk elongate or elongate-fusiform; tail heterocercal. Bones of the cranial roof forming a discontinuous shield, with vacuities and with a median longitudinal series of small azygous elements on the rostral region; snout much produced and eye far forwards; mouth large, with minute teeth in both jaws throughout life; no premaxilla; operculum and suboperculum present, but no branchiostegal rays. Squamation of trunk rudimentary or absent; the lateral rhombic scales and large fulcral scales on the upper caudal lobe robust.

Only two genera of this family are recognized among existing fishes, namely, *Polyodon* (or *Spatularia*) from the Mississippi, and *Psephurus* from Chinese rivers. Fossil remains are very rare, and only one definable extinct genus has hitherto been discovered. A fragmentary specimen, however, from the English Chalk may perhaps represent another member of the family.

A detailed description of the skeleton of *Polyodon* is given by T. W. Bridge in Phil. Trans. 1878, pp. 683–733, pls. lv.–lvii. A figure of the skull is also published by R. H. Traquair, Ganoid Fishes Brit. Carb. Form. (Palæont. Soc. 1877), pl. vii. fig. 1.

Genus **CROSSOPHOLIS,** Cope.

[Amer. Nat. 1883, p. 1152 (*Crassopholis*).]

External bones unornamented; rostrum with small stellate bones. Dorsal and anal fins short-based and remote, the former arising in advance of the latter; caudal fin inequilobate, the upper lobe predominant. Scales of trunk small and thin, each in the form of a small grooved disc with several posterior denticulations, arranged in oblique series, but not in contact; caudal fulcral scales numerous, broad at the base of the lobe, but becoming slender in its distal portion.

? *A. molassicus*, H. Reng°, p. 19, pl. iii, f. 7.

Paleopsephurus wilsoni gen. et sp. nov.
U. Cret. Montana, A. MacAlpin 1941
Bull. Geol. Soc. Amer. 52 p. 1989 [Ann. Arbor Michigan] A. MacAlpin 1947, Contrib. Mus. Pal. Univ. Michigan 6 no. 8 p. 167 ff. 1-3, 5, 7-11, 19-21 pls. i-iv.

1908. Crossopholis magnicaudatus, L. Hussakof, Bull. Amer. Mus. Nat. Hist. vol. xxv. p. 69.

1948. C. m. A. MacAlpin Contr. Mus. Pal. Univ. Michig. 6 no. 8. p. 169 pl. v.

1909. Pholidurus disjectus, A. S. Woodward, Fos. Fishes English Chalk (Pal. Soc.), p. 170, text-fig. 48.

Crossopholis magnicaudatus, Cope.

1883. *Crassopholis magnicaudatus,* E. D. Cope, Amer. Nat. vol. xvii. p. 1153.
1885. *Crossopholis magnicaudatus,* E. D. Cope, *ibid.* vol. xix. p. 1090.
1886. *Crossopholis magnicaudatus,* E. D. Cope, Mem. National Acad. Sci. vol. iii. p. 161, pl. with figs. 1–3.

Type. Portion of trunk; Amer. Mus. Nat. Hist.

The type species, with rostrum relatively shorter than in *Polyodon folium*, and the operculum larger. Bases of the teeth round and closely apposed. Dorsal fin-supports 16–18 in number, and rays probably 24. Scales subquadrate and more widely separated anterior to the dorsal fin than posterior to it.

Measurements of type specimen:—Length from notch of caudal fin to line of origin of dorsal, 0·17; depth at origin of anal, 0·06; depth of caudal pedicle, 0·035; length of inferior caudal lobe, 0·11; depth and diameter of scales about 0·001 (*Cope*).

Form. & Loc. Eocene: Wyoming, U.S.A.

Not represented in the Collection.

not a Polyodon acc. to Macalp
941 Bg-S.Am.52
1948.

Genus **PHOLIDURUS,** A. S. Woodward.

[Proc. Geol. Assoc. vol. xi. 1889, p. 31.]

A provisional name applied to a Cretaceous Chondrostean fish known only by a portion of the tail. The caudal fulcral scales much resemble those of *Psephurus*, but are broader and flatter, less pointed, and evidently indicate a stout depressed fish. The caudal fin-rays are ornamented with ganoine.

Pholidurus disjectus, A. S. Woodward.

1889. *Pholidurus disjectus,* A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 31, pl. i. figs. 4, 5.

Type. Portion of tail; British Museum.

The type species, known only by the fragment mentioned below. Caudal fulcral scales very flat, with rounded and obtuse apex; their exposed surface ornamented with thick ganoine in irregular dots and short wavy lines, more or less clustered, especially near the margin. Caudal fin-rays very robust, the superficial ganoine thick and rugose, not always completely covering the exposed faces of the successive joints.

It is still uncertain whether or not the portion of a depressed rostrum described, *loc. cit.* p. 31, pl. i. fig. 6, belongs to this fish. Having made a renewed examination of the Jurassic Cœlacanths at

Munich, the writer is now inclined to withdraw his comparison of this fossil with the supposed rostrum of those fishes (see *supra*, Pt. II. p. 395).

Form. & Loc. Senonian: Kent.

33221–24. Type specimen, being a portion of the tail described and figured, *loc. cit.*; Upper Chalk, Gravesend. The largest caudal fulcral scale measures 0·024 in maximum breadth, and 0·027 from the apex to the bifurcation of the base.
Taylor Coll.

Division B.—*Baseosts rudimentary or absent in pelvic fins; dermal rays of dorsal and anal fins equal in number to the endoskeletal supporting elements; tail never heterocercal, usually abbreviate-heterocercal or homocercal, rarely diphycercal.*

Suborder II. *PROTOSPONDYLI.*

Notochord persistent, or if more or less replaced by vertebræ, the pleurocentra and hypocentra in part of the caudal region remaining distinct and alternating even when fully developed; tail abbreviate-heterocercal. Mandible complex, with well-developed splenial rising into a coronoid process, which is completed by a distinct coronoid bone. Infraclavicular plates wanting in the pectoral arch; pectoral fin with more than five basals. Scales ganoid. In the living forms—air-bladder connected with the œsophagus in the adult, optic nerves not decussating, but forming a chiasma, and intestine with a spiral valve.

Synopsis of Families.

I. Mandibular suspensorium vertical or inclined forwards and gape of mouth small.	
Trunk more or less deeply fusiform; vertebræ not more than rings; teeth styliform or tritoral; fulcra large, and dorsal fin not extending more than half the length of the trunk ..	Semionotidæ (p. 49).
Trunk elongate or elongate-fusiform; vertebræ not more than rings; teeth styliform; fulcra variable, and dorsal fin extending at least half the length of the trunk	Macrosemiidæ (p. 163).

Bobasatrania forresi !

incl. Ecrinesomus II p. 541.

B. groenlandica Lead descr. + figs. & Nielsen 1952. Medd. dansk Geol. Foren., 12 p. 197 2 figs.

(vm. Tanner 1936, Proc. Utah Acad. Sci. 13 p. 82.)

Bobosatrania also incl. Haya undata Ky. V. p. 478.

Relation to Platysomidae (Pycnodont, Eomesodon) ek. ex Lehman 1956 p. 28. Ann. Pal. 42

B. madagascariensis J.P. Lehman, 1957 Ann. Paleont. 42 p. 16 figs. 5, 6 pl. ii f. B; iii A, V, VI – ix. B. cf. m. J.P. Lehman et al. 1959 fig. 8-10 pl. vi; viii f. C, x f. B. S.W. Madagascar.

Platysomus brewsteri = Bobasatrania II 550.

48C

†*Helmolepis* **gen. n.** p. 283, *gracilis* **sp. n.** Triassic Greenland p. 284 pls. xi fig. 2, xii figs. 2–3, STENSIÖ Medd. Grønland **83** (3). *1932.*

"*Bobasatrania*" *canadensis* L.S. Russell 1937. Bull. Nat. Mus. Canada 123 p. 218 ff pl. xlvi. *Platysomus canadensis* s.h. L.M. Lambe, Tr. R.S. Canada (3) 8 1914 p. 17. H. pl. L. Trias. Alberta. *Lambeichthys* gen. nov. J.P. Lehman 1957 Ann. Paleont 42. p. 16.

33221–24. Desl. & fig? Loc. cit. 1909.

Ichthyolithes (Chondrosteorum) nudus, O.M. Reis, Rech. géol. min. chemin de fer de Sibérie, pl. 29 (1909), p. 19, pl. i. fig. 7. — Jurassic; Turga. [Fragment; Acad. Sci. Petrograd.]

(F. Priem, 1924 Ann. de Pal. 13 xii p. 8 pl. ix f. 1 (Eurynotus crenatus)

Bobasatrania mahavavica, g. et n. E.I. White 1932, Ann. Mag. N.H. (10), X. p. 80 fig. L. Trias; N.E. Madagascar. (Fish in matrix; B.M.). J.P. Lehman 1956 Ann. Paleont. 42 p. 16 pls 1 pls.

BOBASATRANIIDAE.

†*Bobasatrania* gen. n., *mahavavica* **sp. n.** Triassic Madagascar, WHITE Ann. Mag. Nat. Hist. (10) **10** p. 80 fig.; *B.* notes p. 127, *B. groenlandica* **sp. n.** Triassic Greenland p. 132, pls. xiii–xviii, xix figs. 3–5, xxxi figs. 2–3, xxxviii fig. 3, text-figs., STENSIÖ t.c. *1932.*

PARASEMIONOTIDÆ.

Parasemionotus.

Watsonulus?

†OSPIIDAE.

New family, STENSIÖ Medd. Grønland **83** (3) p. 225. *1932.*

†*Ospia* **gen. n.** p. 226, *whitei* **sp. n.** Triassic Greenland p. 227 pls. xix fig. 1, xxiii–xxiv, xxv fig. 1, xxxiii figs. 1–3, text-figs., STENSIÖ t.c.

†*Broughia* **gen. n.** p. 266, *B. perleidoides* **sp. n.** Triassic Greenland p. 268 pls. xxv fig. 2, xxvi figs. 2–3, xxx fig. 1, xxxi fig. 1, xxxvii figs. 1–2, text-figs., STENSIÖ t.c.

Arkansas (1937) p. 360 ff 100 scale sketches.

Ganoid fish fr. U. Gondwana of Uruguay, K. Walther, Ch. f. Min, 1932 B. x. p. 530 ff.

For SUB-HOLOSTEI see

Brough 1939. Triassic Fishes of Besano B.M.

Discussion see Schaeffer & Dunkle 1950 Am. Mus. Nov. 1457.

Cephaloxenidae

Cephaloxenus macropterus, g. n. s. J. Brough 1939, Trias Fishes Besano, p. 19, Hf. 7 & pl. iii f. 4. [Trias: Lombardy. Fish. B.M. (Restoration)]

Luganoridae

Luganoria lepidosteoides, g. n. s. J. Brough 1939 ibid. p. 41. Hf. 15, 16, 18a pl. v. f. 1. Trias: Lombardy, Switz. Fish: B.M. (Rosd.).

Lug. intermedia, s. n. Brough 1939, ibid. 45, Hf. 17, 18a, pl. vi. f. 2 Trias: Lombardy; Fish. B.M.

Lug. macrodentata, s. n. Brough 1939, ibid. 47. Hf. 19, pl. vi. f.

Trias: Lombardy; Fish B.M.

Besania micrognathus g. n. s. n. Brough 1939, ibid. p. 50, Hf. 20, pl. vi. f. 4. ibid. do.

Aetheodontidae

Aetheodontus Besanensis, g. n. s. J. Brough 1939 ibid. p. 52. Hf. 21-24, pl. vii. Trias. Lombardy. [Fish. B.M.].

Turgusichthyidae.

Turgusichthys g. n. Berg. 1940. Trav. { T. acentrophoroides. T. derjugini s. n. Inst. Zool. Acad Sci URSS.

V. liv. 3. pp. 189, 406. (n. n.) & Berg. 1941. Bull. Acad. Sci. URSS. Sc. biol. [illegible] 1941 pt. 3 p. 462. figs. 7-18. L. Triassic, Siberia. [Trans. Pal. Inst. Acad. Sci.]

see Stensiö E.A 1925. Trias. Fishes Spitzb. vol. ii. p. 224.

Also Brough 1936° & 1939° Przeglad 1941 Ann. Pol. 28 p. 87-8.

Schaeffer Bull. Am. Mus. HOLOSTEI, D.H. Ray. 1941 Bull. Rev. 16 p. 28.

Stensiönotus intercessus g. n. Estrias: Madagascar
J. P. Lehman 1952, K. Sv. Vet.-Akad. Handl. (4) 2:n, 6, p. 182 fig. 124, pl. 41 f. C. [Fish. M. H. N. Paris].

Jacobulus novus g. n. Estrias: Madagascar.
J. P. Lehman 1952. ibid. p. 184 figs. 125, 126, 128 pl. 44. [Fish M. H. N. Paris].

Thomasinotus divisus g. n. Estrias: Madagascar.
J. P. Lehman 1952 ibid. p. 187, fig. 129, pl. 43 figs A, C. [Fish: B. M.] Th. sp. J. P. Lehman et al. 1957 Com. Pêches Léon 4:s: 197. Text-figs. 17-18 pl. x f. A, x i. S. W. Madagascar.

Order Incert. Fr. R. S. S. Antarctica
Leighisaurus hillsi g. n. R. T. Lunde 1953, 76:n p. 80 pl. vii [Fish: Univ. Adelaide]

Trunk deeply fusiform or cycloidal; no ossifications in notochordal sheath; teeth tritoral; opercular apparatus reduced; fulcra absent, and dorsal fin elongated..... PYCNODONTIDÆ (p. 189.)

II. Mandibular suspensorium inclined backwards and gape of mouth wide.

Trunk elongate or fusiform; vertebræ very rarely more than incomplete rings; marginal teeth large and conical, becoming minute on most of the inner dentigerous bones; premaxillæ in contact mesially; fulcra large, and dorsal fin short .. EUGNATHIDÆ (p. 285).

Trunk elongate or elongate-fusiform; vertebræ variable, often complete discs; marginal teeth large and conical, inner teeth mostly minute; premaxillæ in contact mesially; fulcra minute or wanting, and dorsal fin variable in length ..... AMIIDÆ (p. 360).

Trunk elongate-fusiform; notochord persistent, sometimes with very feeble ossifications in the sheath; ethmoid fused with the vomers and forming a prominent rostrum, which separates the premaxillæ; teeth large and conical on part at least of all the dentigerous bones; fulcra minute or absent, fin-rays slender and closely set, and dorsal fin short ..... PACYCORMIDÆ (p. 374).

Family SEMIONOTIDÆ.

Trunk more or less deeply fusiform, rarely cycloidal. Cranial and facial bones all robust and opercular apparatus complete, but branchiostegals sometimes reduced; parietals meeting in the middle line; mandibular suspensorium vertical or inclined forwards, and gape of mouth small; teeth styliform or tritoral, especially well-developed on the inner bones of the mouth, and with vertical successors. Notochord persistent, the vertebræ never advancing beyond the annular stage. Fin-rays robust, the majority well-spaced, articulated and divided distally; fulcra large; dorsal fin not extending more than half the length of the trunk. Scales rhombic, except occasionally in the caudal region.

The osteological characters of this family are best known in *Lepidotus* and *Dapedius*, and a detailed description of each of those genera is given below (pp. 78, 128).

Synopsis of Genera.

I. Trunk regularly and deeply fusiform.
  (*a*) Teeth all styliform, or reduced within the mouth.
    Dorsal fin arising well in advance of anal; no enlarged ridge-scales .. *Acentrophorus* (p. 51).
    Dorsal fin arising well in advance of anal; dorsal ridge-scales prominent *Semionotus* (p. 55).
    Dorsal fin arising well in advance of anal; scales comparatively thin, and much the thinnest on caudal region; no enlarged ridge-scales.. *Aphnelepis* (p. 64).
    [Genus known only by detached scales, which are much deeper than broad, with a narrow overlapped margin, a large peg-and-socket articulation, and no sharp inner keel; hinder border denticulated. *Serrolepis* (p. 65).]
    Dorsal fin opposed to anal; dorsal and ventral ridge-scales prominent .. *Pristisomus* (p. 66).
  (*b*) Marginal teeth styliform; inner teeth stouter and mostly tritoral.
    [Genus known only by marginal teeth, of which crown is expanded to chisel- or gouge-shaped edge .... *Sargodon* (p. 67).]
    Dorsal fin arising well in advance of the anal, both these fins much elevated and fringed with fulcra which are scarcely enlarged at the base; angles of overlapped margin of scales not produced .. *Colobodus* (p. 68).
    Dorsal fin arising well in advance of the anal, neither of these fins excessively elevated, but with a cluster of enlarged fulcra at the base; angles of overlapped margin of scales produced forwards; no gular plate ..... *Lepidotus* (p. 77).

II. Trunk much deepened, often irregular in form.
    Trunk very deeply fusiform or regularly cycloidal; teeth stout and styliform, clustered within the mouth; dorsal fin much extended and anal opposed to its hinder half; all scales rhombic, with feeble inner rib; ridge-scales inconspicuous ..... *Dapedius* (p. 128).

Semionotid fish Permo-Triassic of Uruguay, K. Walker, 1933°, p 65, pl.

Paracentrophus madagascariensis.
gen. et sp. nov. J. Piveteau 1946, Ann. Paléont 28 [1939-40], p. 78 figs. 7-10 pl. xf. 1-6.
Fossil. L. Trias madagascar.

Teleopteinidae

Teleopteina improvisa n.g. n. L.S. Berg, C.R. Acad. Sci. URSS. IV(XIII), 1936 p. 346, fig. Fish: U.S.N.M., U. Calif., Mason Creek, Ill. orig. referred to Rhadinichthys gracilis (N. Smith) see p. 469 vol. II. A Pygopterus acc. to T.S. Westoll 1938a.

Acentrophoridae Berg 1936, C.R. Acad. Sci. URSS. p. 3[illegible]

Description of Acentrophorus by E.L. Gill, Proc. Zool. Soc. 1923, p. 19, with figs.

1923. A.V. L. Gill, P.Z.S., p. 19. Fish. Restoration.
1939a. A.V. Moy-Thomas, Palaeozoic Fishes, p. 122, fig. 32. (Rest.)

Trunk irregularly cycloidal, with strongly-arched back; marginal teeth slender and styliform; dorsal and anal fins opposed, not much extended; all scales rhombic, with thick inner rib, very deep and narrow on flank; ridge-scales conspicuous ..... *Cleithrolepis* (p. 154).

Trunk irregularly cycloidal, with strongly-arched back; dorsal fin much extended and anal opposed to its hinder portion; abdominal scales rhombic, with thick inner rib; caudal scales more or less cycloidal ..... *Aetheolepis* (p. 157).

Trunk irregularly cycloidal, with abdominal protuberance; marginal teeth slender and styliform; dorsal fin much extended and anal opposed to its hinder half; all scales rhombic, with thick inner rib, but those of caudal region comparatively delicate; ventral ridge-scales conspicuous ..... *Tetragonolepis* (p. 158).

Genus **ACENTROPHORUS,** Traquair.

[Quart. Journ. Geol. Soc. vol. xxxiii. 1877, p. 565.]

Trunk fusiform. Teeth slender; opercular apparatus well-developed, with a narrow arched preoperculum. Fins small, with very large fulcra; dorsal fin short, opposed to the space between the pelvic pair and the anal; caudal fin symmetrical, slightly forked. Scales rhombic, smooth or feebly ornamented, the dorsal ridge-series inconspicuous; the scales of the flank not much deeper than broad, and those of the ventral aspect nearly equilateral.

All the fishes placed here were originally assigned to the genus *Palæoniscus*, and their distinctness was first pointed out by C. F. Lütken, Palæontogr. vol. xxii. (1873), p. 26, footnote.

Acentrophorus varians (Kirkby).

1862. *Palæoniscus varians*, J. W. Kirkby, Ann. Mag. Nat. Hist [3] vol. ix. p. 267.

1864. *Palæoniscus varians*, J. W. Kirkby, Quart. Journ. Geol. Soc. vol. xx. p. 353, pl. xviii. fig. 2.

1877. *Acentrophorus varians*, R. H. Traquair, Quart. Journ. Geol. Soc. vol. xxxiii. p. 565.

Type. Imperfect fish; Newcastle-upon-Tyne Museum.

The type species, attaining a length of about 0·09. Head with opercular apparatus occupying slightly less than one-quarter of the total length; maximum depth of trunk equalling about twice that of the caudal pedicle, and comprised four times in the total length. Head and opercular bones faintly rugose; operculum broader than deep. Dorsal fin with about 10, and anal with 8 rays. Scales unornamented, not serrated.

Form. & Loc. Upper Permian (Magnesian Limestone): Durham.

36388–90. Two typical specimens, the first wanting the extremity of the snout and the paired fins, the second more imperfect; also a smaller fish; Fulwell Hill, near Sunderland. *Presented by Sir Hedworth Williamson, Bart.*, 1862.

P. 3481 a, b. Two fine specimens about 0·09 in length, somewhat fractured, but showing parts of all the fins; Fulwell Hill. In the second specimen the scales are distinctly shown to be smooth. *Enniskillen Coll.*

P. 3481 c. Slightly smaller fish displaying portions of the median fins; Fulwell Hill. *Enniskillen Coll.*

P. 3481, P. 3483, P. 4342. Four more imperfect specimens, three being much smaller than the preceding; Fulwell Hill. One of the two specimens occurring on a single slab appears to exhibit traces of styliform teeth in the dentary, and enlarged anal scales in advance of the median fin. *Enniskillen Coll.*

P. 1032. Fish about 0·065 in length and two smaller more imperfect specimens; Fulwell Hill. *Egerton Coll.*

P. 1032 a. The hinder abdominal and caudal region of two associated individuals; Fulwell Hill. The dorsal ridge-scales are shown to be relatively large, but not acuminate. *Egerton Coll.*

44210. Small well-preserved fish, wanting the extremity of the head and tail; Fulwell Hill. *Purchased*, 1873.

Acentrophorus abbsi (Kirkby).

1862. *Palæoniscus abbsii*, J. W. Kirkby, Ann. Mag. Nat. Hist. [3] vol. ix. p. 268.

1864. *Palæoniscus abbsii*, J.W. Kirkby, Quart. Journ. Geol. Soc. vol. xx. p. 355, pl. xviii. fig. 3.

1877 *Acentrophorus abbsii*, R. H. Traquair, Quart. Journ. Geol. Soc. vol. xxxiii. p. 565.

1923. "A. a", L. Gill, R.Z.3. p.19. 36 fig. 14 ch..

1923. Q. a. L-Sill, P.Z.S., p. 9. Sp. nov. et.

Type. Imperfect fish; Newcastle-upon-Tyne Museum.

A species about as large as the type, but more slender. Head with opercular apparatus occupying slightly less than one-quarter of the total length; maximum depth of trunk equalling about twice that of the caudal pedicle and comprised at least five times in the total length. Head and opercular bones faintly rugose. Scales unornamented, not serrated, relatively larger than in the type species.

Form. & Loc. Upper Permian (Magnesian Limestone): Durham.

44211. Fish about 0·06 in length, showing some of the supports of the anal and caudal fins, and an enlarged anal scale; Fulwell Hill, near Sunderland. *Purchased*, 1873.

P. 3482. Imperfect remains of a fish about 0·085 in length; Fulwell Hill. *Enniskillen Coll.*

P. 4342 a. Specimen as large as the first showing only fragments of the fins; Fulwell Hill. *Enniskillen Coll.*

P. 4343. More imperfect smaller specimen; Fulwell Hill. *Enniskillen Coll.*

Acentrophorus altus (Kirkby).

1862. *Palæoniscus latus*, J. W. Kirkby (*non* Redfield), Ann. Mag. Nat. Hist. [3] vol. ix. p. 268.

1864. *Palæoniscus altus*, J. W. Kirkby, Quart. Journ. Geol. Soc. vol. xx. p. 356, pl. xviii. fig. 1.

1877. *Acentrophorus altus*, R. H. Traquair, *ibid.* vol. xxxiii. p. 565.

Type. Imperfect fish; Newcastle-upon-Tyne Museum.

A species about as large as the type, but more robust. Head with opercular apparatus occupying at least one-quarter of the total length; maximum depth of trunk equalling about twice that of the caudal pedicle, and comprised only three times in the total length. Head and opercular bones faintly rugose; operculum as deep as broad. Scales unornamented, not serrated.

Form. & Loc. Upper Permian (Magnesian Limestone): Durham.

The only known examples of this species were obtained from the Old Quarry, Fulwell, and there are none in the Collection.

Acentrophorus glaphyrus (Agassiz).

1835. *Palæoniscus glaphyrus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 98, pl. x *c.* figs. 1, 2.

1850. *Palæoniscus glaphyrus*, W. King, Permian Foss. (Pal. Soc.), p. 224, pl. xxii. fig. 3 (? fig. 4).

1855. *Palæoniscus glaphyrus*, F. M'Coy, Brit. Palæoz. Foss. p. 607.
1877. *Acentrophorus* (?) *glaphyrus*, R. H. Traquair, Quart. Journ. Geol. Soc. vol. xxxiii. p. 562.

Type. Imperfect fish; York Museum.

Form and proportions as in the type species, but scales conspicuously serrated.

Form. & Loc. Upper Permian (Marl Slate): Durham and Northumberland. Base Manchester Marls, Winwick, Lancs core CGS DT660, A)

There are no typical examples of this species in the Collection; but the undermentioned are probably to be regarded as small (or young) specimens, according to Egerton (in King, Permian Foss. p. 225, pl. xxii. fig. 4):—

35732. Imperfect trunk, exhibiting traces of serrations on the scales; Marl Slate, probably from Midderidge, Durham. *Purchased*, 1860.

P. 52. Fine specimen 0·043 in length, showing all the fins but not exhibiting any serrations on the scales preserved; Marl Slate, Ferry Hill, Durham. *Presented by Rev. Canon Greenwell*, 1880.

P. 355. Two similar but more imperfect fishes; Ferry Hill. *Purchased*, 1881.

P. 5140. Elongated smaller specimen 0·035 in length; Marl Slate, Cullercoats, Northumberland. *Presented by William Dinning, Esq.*, 1886.

41317. A more imperfectly preserved small specimen, in counterpart; Ferry Hill. *Purchased*, 1869.

A larger fish than any of the preceding, too imperfectly preserved for certain determination, but very much resembling *Acentrophorus*, is described by J. S. Newberry from the Trias of Chicopee Falls, Mass., U.S.A., under the name of *Acentrophorus chicopensis* (Foss. Fishes Trias. N. Jersey and Connecticut, 1888, p. 69, pl. xix. figs. 3, 4). The type specimens are preserved in Yale College Museum, New Haven, Conn., and there are no examples in the Collection.

To this genus A. Fritsch also ascribes some fragmentary remains from the Lower Permian of Bohemia, under the name of *Acentrophorus dispersus* (Fauna der Gaskohle, &c., Böhmens, vol. iii. 1894, p. 81, woodc. no. 279, pls. cxiii., cxiv.).

1931. Acentrophorus staphyaeus (sic), W. Laatsch, Palaeont. iv. p. 187, pl. xvii. f. 8; xx, 1-2.
1923, A.g. L-S. ii, P.Z.S., p. 9, figs. etc.

Phanerorhynchus armatus, E. L. Gill, Ann. Mag. N. H. [9] vol. xi (1923), p. 465, with fig.
"Fish allied to Acentrophorus", A. S. Woodward, Proc. Geol. Soc. 1915, p. lxxiii. — M. Coal Meas.; Sparth, nr. Rochdale. [Imperfect fish; Manchester Museum.]

Acentrophorus sp., A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palaeont. no. 10 (1908), p. 21, pl. iv. fig. 6. — Hawkesbury Beds; St. Peters, Sydney. =
Promecosomina formosa see p. 626.

There is a species of Acentrophorus from the Kupferschiefer of Eisleben in the Halle Museum; also another specimen from same formation in Dr. J. Felix' collection. Abh. May 9th. & 10th. 1897.
See K. von Fritsch, Abh. naturf. Ges. Halle, no. 24 (1906), pl. xi, fig. 1.

Semionotus howelli sp. nov. U. Tries. Pennsylvania
W-Beck 1954. Geol. Surv. Res. Ser. Penn. Philad.
p. 120 Pl. 52 pl. 22 f. 1. Pitt Acc Sii

1901. *Semionotus bergeri*, E. Schellwien, Schrift. phys.-ökon. Ges. Königsberg, vol. xlii. p. 3, pl. ii. figs. 5, 6; pl. iii. fig. 1.

1957 S. b. E. Rutte, Einführung in die Geologie von Mainfranken, Würzburg Lf. 26 p. 76

Genus **SEMIONOTUS,** Agassiz.

[Neues Jahrb. 1832, p. 144.]

Syn. *Ischypterus,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. iii. 1847, p. 277.

Trunk fusiform. Marginal teeth slender, conical, and somewhat spaced, inner teeth stouter; opercular apparatus well-developed, with a narrow arched preoperculum. Ribs ossified. Fin-fulcra large. Paired fins small; dorsal fin large, arising at or behind the middle of the back and in part opposed to the relatively small anal; caudal fin slightly forked. Scales smooth or feebly ornamented, and the narrow overlapped margin not produced at the angles; flank-scales not more than twice as deep as broad, and those of the ventral aspect nearly as deep as broad; the dorsal ridge-series of acuminate scales forming a prominent crest.

Semionotus bergeri, Agassiz.

[Plate II. fig. 3.]

1832. *Palæoniscum arenaceum,* H. A. C. Berger, Verstein. Sandst. Coburg. Gegend. p. 18, pl. i. fig. 1.
1833. *Semionotus spixi,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 8 (name only).
1833–36. *Semionotus bergeri,* L. Agassiz, *ibid.* pp. 8, 224, pl. xxvi. figs. 2, 3.
1834. *Semionotus bergeri,* L. Agassiz, Neues Jahrb. p. 380.
1843. *Semionotus esox,* H. A. C. Berger, Neues Jahrb. p. 86. [Distorted fish; Royal Geological Museum, Göttingen.]
1851. *Semionotus bergeri,* C. von Schauroth, Zeitschr. deutsch. geol. Ges. vol. iii. p. 405, pl. xvii.
1854. *Semionotus,* J. G. Bornemann, *ibid.* vol. vi. p. 612, pl. xxv.
1854. *Semionotus bergeri,* H. A. C. Berger, Neues Jahrb. p. 321.
(?) 1861. *Semionotus bergeri,* O. Fraas, Württ. Jahresh. vol. xvii. pp. 93, 94, pl. i. fig. 6.
1864. *Semionotus bergeri,* J. Strüver, Zeitschr. deutsch. geol. Ges. vol. xvi. p. 305, pl. xiii. figs. 1, 3, 4.

Type. Imperfect fish; University Geological Museum, Göttingen.

The type species, a fish more than three times as long as its greatest depth, attaining a length of about 0·18. Trunk regularly fusiform, the depth of the caudal pedicle somewhat more than one-third as great as the maximum depth of the abdominal region. Head with opercular apparatus occupying nearly one-quarter of the total length; the external bones sparsely tuberculated. Pelvic fins arising nearly midway between the pectorals and the anal; dorsal fin arising immediately behind the middle of the back, much

more than half as deep as the trunk at its point of origin and comprising about 16 rays; anal fin opposed to the hinder half of the dorsal, the longer rays when adpressed reaching to the base of the caudal. Scales smooth, except those of the middle of the flank, which are almost as broad as deep and crimped towards their serrated posterior border; dorsal ridge-scales sharply pointed.

Form. & Loc. Keuper: Coburg and Thuringia.

P. 7399. Slab of sandstone with three imperfect individuals, variously crushed, in counterpart; Coburg. One specimen is shown of the natural size in Pl. II. fig. 3. The differences in the curvature of the dorsal margin are conspicuous and doubtless due entirely to accidental distortion. Some of the head and opercular bones are shown, ornamented with sparse tuberculations; and part of the upper jaw of one individual exhibits a few stout conical teeth, which were not improbably arranged upon the vomer, while traces of spaced, slender, styliform teeth occur in the opposing lower jaw. Some of the fin-rays are well displayed, exhibiting the unjointed base and the very close articulations beyond. *Purchased*, 1884.

P. 3623. Obscure remains of small specimen; Coburg.
Enniskillen Coll.

Semionotus kapffi, Fraas.

1861. *Semionotus kapffii*, O. Fraas, Württ. Jahresh. vol. xvii. pp. 91, 95, pl. i. figs. 1–3.

Type. Imperfect fishes; Stuttgart Museum.

A small species, about two and a half times as long as its maximum depth, attaining a length of about 0·1. Trunk deeply fusiform, the depth of the caudal pedicle not more than one-third as great as the maximum depth of the abdominal region. Head with opercular apparatus occupying nearly one-quarter of the total length; snout acutely pointed. Pelvic fins arising much nearer to the anal than to the pectoral fins; median fins as in the type species. Scales smooth and not serrated, those of the middle of the flank much deeper than broad; dorsal ridge-scales produced into slender points.

Form. & Loc. Middle Keuper: Würtemberg.

38654–58. Ten small slabs of sandstone with remains of several individuals; Haslach, near Stuttgart. *Purchased*, 1864.

P. 1545. Imperfect specimen, wanting the caudal extremity; Haslach. *Egerton Coll.*

1901. Semionotus kapffi, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xlii. p. 20.

1905. Semionotus Kapffi, K. Gorjanović-Kramberger, Beitr. Pal. Österr.-Ungarns, xviii. p. 196. t-f. 1. pl. xviii (ii) f. 2. u. Textfig. Hallein. Not S. kapffi — now S. bergeri P. 1091a, P. 1094B.

1929. S. Kapffi, H. Stolley, Jahresb. u. Mitt. oberrhein. geol. Verein. N.F. Bd. XVIII. p. 59. t-f. 12.

Fam. Perleidiidae.

Ind. Meridensia p. , Zenaktiscus p. 61, Bristisomus, p. 66, Chrotichthys ? Tripelta p. 474.

Meidiichthys browni (Broom), n.g. J. Brough, 1931, P.Z.S. p. 261 t.f. 11-12. Pl. iv. f. 1. (see Bhatiasophorus browni, p. 476).

? Mendocinia

Fam. Includes Hydropersum (see p. 167).

†PERLEIDIDAE.

†*Perleidus* notes p. 186, *P. staschiensis* sp. n. Triassic Greenland p. 187 pls. xx, xxi figs. 2–4, xxii, xxxii figs. 1–8, text-figs., STENSIÖ Medd. Grønland 83 (3). 1932.

See also Stensiophthys p. 480 & p. 61.

Lindaecamin J. P. Lehman. Ann. Pal. 39 1954 p. 1.

Manlietta crassa, Procleithrichthys ferox, ? Enignathichthys alternatus } g. & spp. n. M. Trias: N.S.W.

Perleidid fm Bemlea, Worcs. E. I. White 1950, Tr. Worcs. Nat. Club. 1948-49 p. 185, 1 pl.

Perleidus lusitanicus sp. n. C. Texeira 1948 Not. Not. Est. Portugal 7 p. 1. Trassic Portugal; 1958 B.S.G. Port. 12, 3, 83-92 pls Grecia da Costa Lisboa 9 2, 308. 1960. Publ. with Dr. Thomas 50 57 pl. VIII, IX, 1/2

Fam. Catopteridae.

S. altolepis is not Semionotus, acc. to E. Schellwien, Schriftl. Phys.-ökonom. Ges. Königsberg, vol. xlii (1901), p. 25. Referred to new genus named Perleidus, family Catopteridae, by G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 49, pl. ii. fig. 2. pl. 3

Perleidus altolepis, E. A. Stensiö, "Triassic Fishes from Spitzbergen," pt. 1, (1921), t-figs. 75, 79. (Confirmed as Catopterid.)

Perleichus madagascariensis n. sp.

Perleidus woodwardi E. A. Stensiö, loc. cit. (1921) p. 257, pl. 28, fig. 3; pls. 33, 34; pl. 35, figs. 1–3, t-figs. 80-87. (New name for Colobodus altilepis A.S.W. see p. 76.) Colobodus altilepis, E. Andersson, Bull. Upsala Geol. Inst. vol. xv, 1916.

cf. W. N. Chow 7th. Linc 1957, Acta pal. Sinica 5, 2: 304 pl. ii Stensiö Pr. (1921)

38660. Several portions of sandstone with remains chiefly of this species; Stuttgart. *Purchased*, 1864.

2845. Two specimens exhibiting portions of the squamation and the median fins of a large individual; Stuttgart.
Van Breda Coll.

Semionotus brodiei, Newton.

1887. *Semionotus brodiei*, E. T. Newton, Quart. Journ. Geol. Soc. vol. xliii. p. 539, pl. xxii. figs. 1–7.

Type. Imperfect fishes; collection of Rev. P. B. Brodie.

A small imperfectly known species, attaining a length of about 0·1. The maximum depth of the trunk equalling nearly half its length from the pectoral arch to the base of the caudal fin, and the caudal pedicle slender. Pelvic fins arising midway between the pectorals and anal, immediately in advance of the dorsal. Scales almost entirely smooth, a few with feeble traces of oblique ridges; those of the anterior part of the flank serrated and about twice as deep as broad.

The apparently great depth of the principal flank-scales in this species is probably exaggerated by crushing in the imperfect specimens hitherto discovered.

Form. & Loc. Upper Keuper: Warwickshire.

P. 5207. Imperfect distorted trunk, noticed and scales figured *loc. cit.* p. 537, pl. xxii. fig. 7; Shrewley.
Presented by Rev. P. B. Brodie, 1886.

Semionotus altolepis, Deecke.

1889. *Semionotus altolepis*, W. Deecke, Palæontogr. vol. xxxv. p. 120, pl. vi. fig. 10.

Type. Nearly complete fish.

A species attaining a length of about 0·12. Trunk regularly fusiform, the depth of the caudal pedicle about one-third the maximum depth of the abdominal region. Length of head with opercular apparatus nearly equal to the maximum depth of the trunk, and somewhat exceeding one-quarter of the total length of the fish; external bones ornamented with tubercles and rugæ. Dorsal fin arising about the middle of the back, and the anal fin arising opposite its hinder extremity. Scales smooth, those of the flank in part about twice as deep as broad, and all the principal scales serrated.

Form. & Loc. Muschelkalk: Perledo, Como, Italy.

Not represented in the Collection.

Semionotus capensis, A. S. Woodward.

1888. *Semionotus capensis,* A. S. Woodward, Quart. Journ. Geol. Soc. vol. xliv. p. 138, pl. vi. figs. 1–5.

Type. Nearly complete fishes; British Museum.

A species attaining a length of about 0·18. Trunk regularly fusiform, with comparatively slender caudal pedicle. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and contained four times in the total length of the fish; external bones smooth. Pelvic fins arising nearly midway between the pectorals and the anal; dorsal fin arising about the middle of the back, behind the origin of the pelvic pair, and comprising 12 rays; anal fin arising opposite the hinder extremity of the dorsal, with about 8 rays, the longest when adpressed reaching to the base of the caudal. Scales smooth, none serrated, and those of the flank scarcely deeper than broad.

Form. & Loc. Upper Karoo Formation (Stormberg Beds): Ficksburg, Orange Free State, South Africa.

P. 4089. The type specimen, being a slab partly in counterpart, with remains of four fishes.
Presented by the Orange Free State National Museum, through Hugh Exton, Esq., M.D., 1883.

P. 6861. Slab with remains of six fishes, partly in counterpart. Impressions of the styliform teeth are well shown in one specimen. *Presented by H. Savory, Esq.,* 1893.

P. 6943. Three specimens, one head displaying the styliform teeth in the premaxilla and some of the circumorbital bones in impression. *Presented by David Draper, Esq.,* 1893.

Semionotus fultus (Agassiz).

1833–36. *Palæoniscus fultus,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 4, 43, pl. viii. figs. 4, 5.
1841. *Palæoniscus fultus,* W. C. Redfield, Amer. Journ. Sci. vol. xli. p. 25.
1841. *Palæoniscus macropterus,* W. C. Redfield, *ibid.* p. 25.
1847. *Ischypterus fultus,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. iii. p. 277.
1850. *Ischypterus fultus,* Sir P. Egerton, *ibid.* vol. vi. pp. 8, 10.
1877. *Ischypterus fultus,* R. H. Traquair, *ibid.* vol. xxxiii. p. 559.
1888. *Ischypterus fultus,* J. S. Newberry, Foss. Fishes Trias. N. Jersey and Connecticut (Mon. U.S. Geol. Surv. no. xiv.), p. 34, pl. vi. fig. 2, pl. vii. fig. 1.
1888. *Ischypterus macropterus,* J. S. Newberry, *ibid.* p. 41, pl. xii. fig. 1.

1901. Semionotus capensis, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xlii. h. 1, pl. i; pl. ii. figs. 1-4; text-f. 1-3.

1909. Semionotus capensis, R. Broom, Ann. S. Afric. Mus. vol. vii. p. 262.

1915. Semionotus capensis, E. Hennig, SB. Ges. Naturf. Freunde Berlin, 1915, p. 49, pl. iii.

1957. S. C. S. Gaffroy, Bull. Soc. Géol. France (6) 6 847-859, ff 2, 3 pl. xxviii. S. W. Carmichael.

1857, Ischypterus fultus Macropterus E. Emmons. Amer. Geol. vi. p. 143 pls 9, 9a.

1901. Semionotus semiceps, W. H. Hobbs (errore), 21st Ann. Rep. U. S. Geol. Surv. pt. iii. p. 56, pl. iii. fig. A.

1901. Semionotus fultus, E. Schellwien, Schrift. Phys.-oekon. Ges. Königsberg, vol. xlii, p. 29, pl. iii. figs. 1-5.

1903. Semionotus fultus, G. F. Eaton, Amer. Journ. Sci. [4] vol. xv. p. 261, pl. v. figs. 1-4.

1905. Semionotus fultus, C. R. Eastman, Ann. Rep. State Geol. New Jersey 1904, p. 83, pl. ii. figs. 1-4; pl. ix; text-fig. 12.

1911. Semionotus fultus, C. R. Eastman, Bull. 18. Connect. Geol. & N.H. Survey, p. 64, pl. iii.

1936. ? Semionotus fultus, M. R. Thorpe, p. 319. ff. 1.

Type. Imperfect trunk, wanting head.

The type species of the so-called *Ischypterus*, attaining a length of about 0·2. Trunk regularly fusiform, the depth of the caudal pedicle more than one-third as great as the maximum depth of the abdominal region. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and somewhat more than one-quarter of the total length of the fish. Pelvic fins arising nearer to the anal than to the pectorals and immediately in advance of the dorsal; anal fin, with seven rays, partly opposed to the hinder half of the dorsal. Scales smooth and not serrated, those of the middle of the flank scarcely deeper than broad; dorsal ridge-scales acuminate.

Form. & Loc. Triassic: Massachusetts, Connecticut, and New Jersey, U.S.A.

P. 1036. Imperfect fish; Durham, Connecticut. *Egerton Coll.*

P. 1035. Fish with well-preserved squamation; Boonton, New Jersey. *Egerton Coll.*

P. 3511. Impression of trunk apparently deepened by distortion in the abdominal region; Massachusetts. *Enniskillen Coll.*

P. 1017 a, b. Two small specimens, one wanting head, the other wanting caudal region; Sunderland, Mass. *Egerton Coll.*

P. 3511 a. Fragmentary remains, probably of this species; Sunderland. *Enniskillen Coll.*

Semionotus tenuiceps (Agassiz).

1835–36. *Eurynotus tenuiceps*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 159, 303, pl. xiv *c*. figs. 4, 5.

1837. *Palæoniscus latus*, J. H. Redfield, Ann. Lyceum Nat. Hist. New York, vol. iv. p. 38, pl. ii.

1837. *Eurynotus tenuiceps*, J. H. Redfield, *ibid.* p. 39.

1841. *Palæoniscus latus*, W. C. Redfield, Amer. Journ. Sci. vol. xli. p. 25.

1841. *Eurynotus tenuiceps*, E. Hitchcock, Geol. Massachusetts, vol. ii. p. 459, pl. xxix. figs. 1, 2.

1850. *Ischypterus latus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. vi. p. 10.

1857. *Eurinotus ceratocephalus*, E. Emmons, Amer. Geology, pt. 6, p. 144, pl. ix *a*. ? cf. fig. 112.

1860. *Eurinotus ceratocephalus*, E. Emmons, Man. Geology, ed. 2, p. 188, fig. 164.

1877. *Ischypterus latus*, R. H. Traquair, Quart. Journ. Geol. Soc. vol. xxxiii. p. 559.
1888. *Ischypterus tenuiceps*, J. S. Newberry, Foss. Fishes Trias. N. Jersey and Connecticut (Mon. U.S. Geol. Surv. no. xiv.), p. 32, pl. v. figs. 1–3, pl. vii. fig. 3.
1888. *Ischypterus latus*, J. S. Newberry, *ibid.* p. 46, pl. xiii. fig. 3.
1889. *Allolepidotus americanus*, W. Deecke, Palæontogr. vol. xxxv. p. 114.

Type. Imperfect fish; Geological Society of London.

A species attaining a length of about 0·2. Trunk with considerably arched dorsal border, the depth of the caudal pedicle more than one-third as great as the maximum depth of the abdominal region. Length of head with opercular apparatus less than the maximum depth of the trunk, and contained four times in the total length of the fish. Fins as in *S. fultus*. Scales smooth and not serrated, those of the middle of the flank in part twice as deep as broad; dorsal ridge-scales large and conspicuous, comparatively obtuse in large specimens.

Form. & Loc. Triassic: Massachusetts, Connecticut, and New Jersey.

38548–49. Two small fishes, imperfectly preserved; Sunderland, Mass. *Purchased*, 1864.

P. 3511 b. Specimen about 0·18 in length; Massachusetts. *Enniskillen Coll.*

P. 1017–8. Four fragmentary specimens, displaying the deepened scales on the flank; Sunderland, Mass. *Egerton Coll.*

P. 7400. Fish 0·145 in length; Connecticut. *Presented by Prof. C. U. Shepard.*

38547. Two similar specimens; Connecticut. *Purchased*, 1864.

28429. Slab with two specimens; Connecticut. *Mantell Coll.*

26591. Middle portion of large fish; Connecticut. *Presented by Dr. J. J. Bigsby*, 1851.

P. 3512. A very large imperfect specimen, doubtfully of this species; Boonton, New Jersey. *Enniskillen Coll.*

Semionotus alsaticus, Deecke.

1889. *Semionotus alsaticus*, W. Deecke, Palæontogr. vol. xxxv. p. 104, pl. vi. fig. 1.

Type. Nearly complete fish; Strassburg Museum.

1903. *Semionotus tenuiceps*, G. F. Eaton, Amer. Journ. Sci. [4] vol. xv. p. 295.

1905. *Semionotus tenuiceps*, C. R. Eastman, Ann. Rep. State Geol. New Jersey 1904, p. 86.

1901. *Semionotus alsaticus*, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xlii. p. 24.

Peteridae

Zeuchthiscus, g. n. Wade 1940.

Zeuchthiscus australis R.T. Wade 1940, V. Proc. R. Soc. Vic. 73, 214, cf. S. 6, pl. xi. f. 4. (Incl. S. tenuis).

An elongated species, attaining a length of about 0·15; the depth of the caudal pedicle nearly equalling half the maximum depth of the abdominal region. Length of head with opercular apparatus slightly less than the maximum depth of the trunk, and contained five times in the total length of the fish; external bones coarsely rugose. Pelvic fins relatively large, nearer to the anal than to the pectorals; dorsal fin arising behind the origin of the pelvic pair, about as deep as long, and the anal arising opposite its hinder extremity. Scales smooth, scarcely deeper than broad upon the flank.

Form. & Loc. Bunter Sandstone: Wasselnheim, Alsace.

Not represented in the Collection.

Semionotus tenuis, A. S. Woodward.

1890. *Semionotus tenuis*, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 31, pl. vi. fig. 3. See *S. australis* below

Type. Imperfect fish; Geological Survey Museum, Sydney.

An elongated species, attaining a length of about 0·13; caudal pedicle slender, its depth contained two-and-a-half times in the maximum depth of the abdominal region. Length of head with opercular apparatus not less than the maximum depth of the trunk, and equalling somewhat more than one-fifth of the total length of the fish. Fin-fulcra large and very slender; dorsal fin arising about the middle of the back, the length of the first ray equalling the depth of the trunk at its insertion; anal fin arising opposite the hinder extremity of the dorsal. Scales smooth, those of part of the flank twice as deep as broad.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

Not represented in the Collection.

The following specimens are not specifically determined :—

38659. Imperfect head and abdominal region of a comparatively large and elongated fish with smooth scales; Keuper, Stuttgart. *Purchased*, 1864.

P. 1546. Slab with imperfect remains of three small fishes; Keuper, Coburg. *Egerton Coll.*

The following species of *Semionotus*, all from Europe except the first, have been founded upon specimens which are mostly fragmentary and are not represented in the Collection :—

Semionotus australis, A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4 (1890), p. 31, pl. vi. fig. 2.—

Lower Hawkesbury-Wianamatta Series ; Gosford, New South Wales. [Trunk, wanting head ; Geological Survey Museum, Sydney.]

Semionotus elongatus, O. Fraas, Württ. Jahresh. vol. xvii. (1861), pp. 93, 95, pl. i. figs. 4, 5.—Middle Keuper; Stuttgart. [Distorted fish ; Stuttgart Museum.]

Semionotus gibbus, K. von Seebach, Zeitschr. deutsch. geol. Ges. vol. xviii. (1866), p. 7 (*gibber*, errore) ; W. Deecke, Palæontogr. vol. xxxv. (1889), p. 105.—Bunter Sandstone ; Bernburg, Anhalt. [Fragmentary trunk ; University Geological Museum, Göttingen.]

Semionotus gibbus, F. Bassani (*non* Seebach), Atti Soc. Ital. Sci. Nat. vol. xxix. (1886), p. 37.—Triassic ; Besano, Lombardy. [Nearly complete fish ; Milan Museum.]

Semionotus letticus, O. Fraas, Württ. Jahresh. vol. xvii. (1861), p. 97, pl. i. fig. 8.—Upper Triassic (Lettenkohl); Hoheneck, Würtemberg. [Imperfect fish ; Stuttgart Museum.]

Semionotus nilssoni, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1837), p. 229, pl. xxvii *a*. figs. 1–5 ; B. Lundgren, Kongl. Fysiogr. Sällsk. Minneskr. 1878, no. v. p. 32, pl. ii. fig. 79.—Rhætic ; Hoeganaes, Sweden. [Head and anterior portion of trunk ; Museum of Comparative Zoology, Cambridge, Mass., U.S.A.]

Semionotus serratus, O. Fraas, Württ. Jahresh. vol. xvii. (1861), p. 97, pl. i. fig. 7.—Middle Keuper ; Hütten, Würtemberg. [Anterior portion of fish ; Stuttgart Museum.] (? *Colobodus*.)

Fragments of *Semionotus* have also been described from the Upper Keuper of Colwick Wood, Nottingham (E. T. Newton, Quart. Journ. Geol. Soc. vol. xliii. 1887, p. 539, pl. xxii. fig. 8), and from the Bunter Sandstone of Inzlingen, near Basle, Switzerland (W. Deecke, Palæontogr. vol. xxxv. 1889, p. 104, pl. vi. fig. 7 : Basle Museum) ; and the present writer has examined characteristic specimens from the Rhætic probably of Bur Crowcombe (Bath Museum) and Hapsford Mill, Vallis, Somersetshire.

Nearly complete fishes, variously crushed and distorted and sometimes imperfectly preserved, have been described from the Trias of North America under the following names. They may be conveniently referred to the genus *Semionotus*, and doubtless represent much fewer species than are here enumerated :—

Ischypterus agassizi, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. vi. (1850), p. 10 ; J. S. Newberry, Foss. Fishes Trias.

Collineogenys bowralensis g.n.n. R.T. Wade, 1942, J. Proc. R.S. N.S.W. 75 p. 145, 1 ff. pl. vii f. B. Trias: N.S.W. [Fish: Austral. Mus. Sydney.

S. Ranchensis s.sp. U. Trias Utah. B. Schaeffer & Th. Dunkle 1950 Am. Mus. Nov. 1457. p. 1. 6 ff. [Dist].

Semionotus mendozaensis s.n. H.B. Geinitz, 1876. Palaeontographica Suppl. III, H. i. Pal. Theil ii. p. 2. [Scales: "Rhaetic" Argentine].

S. vallejensis s.n. Rusconi 1950 An. Soc. Cient. argent. 145 4 p. 173 fg. 5 Trias Argent.

S. carinulatus s.n. ~~+ Bonaparte~~ O.G. Costa 1860 Ittiol. fos. nel. p. 49, pl. V (? non. 1, 4) 2a p. 7-4

S. unicostatus s.n. M. Trias Argentina (Mendoza) C. Rusconi 1946 Rev. Soc. hist. geogr. de Cuyo 1 p. 15

6.

= Parasemionotid sec R.T. Wade 1953 J. Proc. R. Soc. N.S.W. 87, p. 72.

Promecosominidae. Wade 1941.
\ Gardiner 1960

Promecosomina formosae incl. Pholidosporus australis (p. 476), Acentrophorus sp. (p. 54. ? Prom. beaconensis p. R.T. Wade 1941, J. Proc. R.S.N.S.W. 74 p. 382.
B.G. Gardiner 1960: Bull. B.M.(N.H.). 4, 341, t.f. 64

Parasemionotus bosaineti s.a. Lotricis S.W. Madagascar
L.P. Lehman 1959 Ann. Paléont. 45: 196, Cf. 16 M. ix f. B.

Semionotus inornatus, J. Henry, Mém. Soc. d'Emulat. Doubs [4] vol. x (1876), p. 417, pl. ii. fig. 23. — Rhetic; Boissets. [Scale only.]

S. elongatus, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xliii (1901), p. 21, text-fig. 6; (?) A. Jegetmeyer, Zeitschr. f. gesammt. Naturw. vol. 47 (1876), p. 469, pl. vii. fig. 5.

Semionotus formosus, A. S. Woodward, Mem. Geol. Surv. N.S. Wales, Palaeont. no. 10 (1908), p. 23, pl. iv. fig. 8. — Hawkesbury Beds; St Peter's, Sydney. [Imperfect fish; Australian Museum.]

= Heterolepidotus gibbus, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. viii (1910), p. 114, pl. viii. fig. 2.

S. lettieus, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xliii. (1901), p. 19, text-fig. 4 ["probably Cahopteroid"]. See p. 3, MS.

S. nilssoni, C. R. Eastman, Bull. Connecticut Geol. & N. H. Surv., no. 18 (1911), p. 71, pl. vi. G. Troedsson 1935 p. 621.

~~Eugyrolobotus Mt Lothian, Midlothian 1953 Geol. Soc. Edinburgh. 3 p. 86.~~

S. serratus, E. Schellwien, Schrift. Phys-ökonom. Ges. Königsberg, vol. xliii (1901), p. 20, text-fig. 5.

Semionotus minor and S. punctatus, A. Robertson, 2. Journ. Geol. Soc. vol. iii (1847), p. 114 (name only). — Jurassic; Brora, Sutherland.

S. Labordei, s.n. = Parasemionotus n.g., J. Piveteau, 1929, C.R. Acad. Sci. Paris. CLXXXIX. p. 1018. (Neotenic with Eugnathid characters important.) 1930, C.R. Acad. Sci. Paris CXCI. p. 1470. Piveteau, 1935; Ann. 1932. C.R. Somm. Soc. Geol. France p. 194. 1934. C.R. Acad. Sci. Paris CXCVIII. p. 110.

S. metcalfei, s.n. Skinnerton, 1928, Geol. Mag. 65: 407, Keuper, Nottingham.

Parasemionotidae nov. fam. Labordeus ch. nov. Brough 1939.

Semionotus agassizi, C. R. Eastman, Ann. Rep. State Geol. New Jersey 1904 (1905), p. 80, pl. i; pl. ii. figs. 5, 9, 10, 12; pl. iii. figs. 1, 2; pls. vii. viii. & Bull. 18, Connect. Geol. & N. H. Surv, 1911 p. 61, pls 1, 2 & f. 8.

Ischyptérus beardmorei, Smith, Metropolitan Magazine, 1900, p. 502.

I. albus = Sem. lineatus acc. to Eastman 1905.
Semionotus brauni, C.R. Eastman, Ann. Rep. State Geol. New Jersey 1904 (1905), p. 93. ~~Palaeoniscus latus L. P. Gratacap (error), Amer. Nat. vol. xx (1886), p. 243, fig.~~

Semionotus elegans, C.R. Eastman, Ann. Rep. State Geol. New Jersey 1904 (1905), p. 91, pl. xii. {S. aff. elegans, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsb. vol. xlii (1901), pl. iii. fig. 4.
Semionotus gigas, C.R. Eastman, Ann. Rep. State Geol. New Jersey 1904 (1905), p. 83. S. cf. gigas, 1935, C.S. Hurse°, p. 525. (Utah).
Semionotus lineatus, C.R. Eastman, loc. cit. (1905), p. 89, pls. x. xi.

Semionotus marshi, G.F. Eaton, Amer. Journ. Sci. [4] vol. xv (1903), p. 264, pl. v. figs. 5, 9, 10, 12, pl. vi. figs. 1, 2. [= S. agassizi acc. to Eastman, 1905.]
Semionotus microptenus,* C.R. Eastman, Ann. Carnegie Mus. vol. ix (1914), p. 146, pl. xxxii. fig. 1; also Ann. Rep. State Geol. New Jersey 1904 (1905), p. 87, pl. ii. figs. 5–8, 11, 13, text-fig. 13. G.F. Eaton, G.F. Eaton, Amer. Journ. Sci. [4] vol. xv (1903), p. 263, pl. v. figs. 6–8. "Ischyp. newberryi, S.W. Loper, Pop. Sci. News 1893."
Semionotus oratus, G.F. Eaton, Amer. Journ. Sci. [4] vol. xv (1903), p. 266; C.R. Eastman, Ann. Rep. State Geol. New Jersey 1904 (1905), p. 78, pls. iv–vi. & loc. cit. infra, (1911) p. 69

Semionotus robustus, C.R. Eastman, Ann. Rep. State Geol. New Jersey 1904 (1905), p. 79.

* S. microptenus: C.R. Eastm. Bull. 18. Connect. Geol. & N.H. Survey, 1911, p. 67 pl. iv.

N. Jersey & Connecticut (Mon. U.S. Geol. Surv. no. xiv. 1888), p. 30, pl. iii. fig. 1 : *Palæoniscus agassizii*, W. C. Redfield, Amer. Journ. Sci. vol. xli. (1841), p. 26.—Trias ; Boonton, New Jersey.

Ischypterus alatus, J. S. Newberry, *op. cit.* p. 37, pl. viii. figs. 1, 2[1].—Trias ; Boonton. [Columbia College, New York.]

Ischypterus brauni, J. S. Newberry, *op. cit.* p. 43, pl. xii. fig. 3, pl. xiii. figs. 1, 2[1] : *Palæoniscus latus*, L. P. Gratacap (*errore*), Amer. Nat. vol. xx. (1886), p. 243, fig.—Base of Trias ; Weehawken, New Jersey.

Ischypterus elegans, J. S. Newberry, *op. cit.* p. 37, pl. vii. fig. 2, pl. x. fig. 1, pl. xiv. figs. 1, 2[1].—Trias ; Boonton. [Columbia College, New York.]

Ischypterus gigas, J. S. Newberry, *op. cit.* p. 49, pl. xiv. fig. 3[1].—Trias ; Boonton. [Amer. Mus. N. H.]

Ischypterus lenticularis, J. S. Newberry, *op. cit.* p. 39, pl. x. figs. 2, 3[1].—Trias ; Boonton.

Ischypterus lineatus, J. S. Newberry, *op. cit.* p. 40, pl. xi. figs. 1, 2[1].—Trias ; Boonton. [Columbia College, New York.]

Ischypterus marshi, W. C. Redfield, Proc. Amer. Assoc. Adv. Sci. (Albany, 1856), pt. 2, p. 188 (name only) ; J. S. Newberry, *op. cit.* p. 28, pl. ii. fig. 1.—Trias ; Sunderland, Massachusetts. [Yale University Museum.]

Ischypterus micropterus, J. S. Newberry, *op. cit.* p. 31, pl. iv. figs. 1, 2, pl. xii. fig. 2[1].—Trias ; Durham, Connecticut.

Ischypterus minutus, J. S. Newberry, *op. cit.* p. 48, pl. xiii. fig. 5[1].—Trias ; Durham. [Amer. Mus. Nat. Hist.]

Ischypterus modestus, J. S. Newberry, *op. cit.* p. 38, pl. ix. figs. 1–3[1].—Trias ; Boonton. [Columbia College, New York.]

Ischypterus ovatus, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. vi. (1850), p. 10 ; J. S. Newberry, *op. cit.* p. 27, pl. i. fig. 1 : *Palæoniscus ovatus*, W. C. Redfield, Amer. Journ. Sci. vol. xli. (1841), p. 26 : (?) *Tetragonolepis*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. iii. (1847), p. 277, pl. ix. fig. 2.—Trias ; Turner's Falls, Mass., Boonton, and (?) Virginia.

Ischypterus parvus, J. S. Newberry (*ex* W. C. Redfield. MS.), *op. cit.* p. 45, pl. xiii. fig. 4[1].—Trias ; Turner's Falls.

Ischypterus robustus, J. S. Newberry, *op. cit.* p. 36, pl. vi. fig. 1[1].—Trias ; Boonton. [Columbia College, New York.]

[1] These names were previously published without definition in Trans. New York Acad. Sci. vol. vi. (1888), p. 127.

The names of *Semionotus balsami*, *brevis*, *dubius*, *inermis*, and *trotti*[1] are given by C. Bellotti (in A. Stoppani, Studii Geol. e Paleont. Lombardia, 1857, pp. 422–427) to fishes of uncertain affinities from the Upper Trias of Perledo, Como. Another unsatisfactorily determined species is also named *Semionotus bellotti*, E. Rüppell, in A. Stoppani, *ibid.* p. 425.

It still remains to be proved that the so-called *Archæosemionotus connectens* (W. Deecke, Palæontogr. vol. xxxv. 1889, p. 121, pl. vi. fig. 3), from the Trias of Perledo, Como, is not founded on an imperfect example of *Semionotus*. The unique type specimen, in the Senckenberg Institute, Frankfort, has probably lost its squamation by accident.

The imperfect trunk of a fish from the Upper Muschelkalk of the neighbourhood of Jena, apparently related to *Semionotus* and its allies, is named *Dolichopterus volitans* by G. Compter, Zeitschr. f. Naturw. vol. lxiv. (1891), p. 41, pl. i. figs. 1–6. It is described as characterized by much-enlarged pectoral fins, and by a comparatively short dorsal opposed to an extended anal. Another imperfect fish, apparently of almost the same systematic position, from the Upper Muschelkalk of Elm, Brunswick, is described and figured without name by W. Dames, Palæont. Abhandl. vol. iv. (1888), p. 173, pl. xvi *a*. fig. 10.

Genus **APHNELEPIS**, A. S. Woodward. see p. 48.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9.]

Trunk laterally compressed and deeply fusiform. Head of moderate size with acuminate snout, and more or less ornamented with rugæ and tubercles; marginal teeth small, stout, and almost conical, closely arranged; inner teeth nearly granular. Notochord persistent, sometimes with small hypocentra and pleurocentra in the caudal region; ribs long. Fulcra conspicuous on all the fins. Pectoral fins of moderate size, somewhat larger than the pelvic pair, which are well developed; dorsal and anal fins acuminate and short-based, the former almost or completely in advance of the latter; caudal fin forked. Scales all rhombic, thin on the abdominal, still thinner on the caudal region; those of the flank deeper than broad, those of the dorsal and ventral borders about as deep as broad; ridge-scales not enlarged.

[1] Described as *Lepidotus trotti* by Balsamo-Crivelli, Ann. Polytecn. Milano, May 1839.

Semionotus balsami, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 69, pl. i. figs. 13, 14, pl. ii. fig. 3. [Includes Sem. dubius, Bell., & Archaeosemionotus connectens, Deecke.]

Sem. bellottii = Allolepidotus bellottii, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 121, pl. viii. figs. 1, 6.

Sem. brevis = Heterolepidotus brevis, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 107, pl. vii. fig. 2.

= Dollopterus volitans, O. Abel, Jahrb. k. k. geol Reichsanst. vol. lvi (1906), pp. 48, 69
E. Stolley, Palaeontogr. vol. lxiii (1920), p. 57, pl. xii. fig. 3.
[Non Dolichopterus, Hall or Aymard. Preoccupied twice.]

Dollopterus brunsvicensis, E. Stolley, Palaeontogr. vol. lxiii (1920), p. 45, pl. xii. fig. 1. — U. Muschelkalk; Lucklum-am-Elm, near Brunswick. [Nearly complete fish; Technical High School, Brunswick.] Also Letten Kohle Lorraine.

Dollopterus subserratus, E. Stolley, loc. cit. 1920, p. 53, pl. xii. fig. 2. — U. Muschelkalk; Lichtenberg, near Salzgitter. [Imperfect fish; Techn. H.S., Brunswick.]

Dollopterus cupiclineus (Lambe) see Eleniothrips cupiclineus, II. 501.

Sinosemiotus urumchii g. et s. n. P. L. Yuan & T. P. Koh 1936, Nat. Tsing Hua Univ., Sci. Repb., Ser. C., I, pp. 1-8, 1 fig., 2 pls, [Trias. Tihua, Sinkiang]. Non vidi, Bull. Geol. Soc. Am. Bibl. iv p. 316.

Lepidotus trotti = Eugnathus trotti, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 97, pl. v. fig. 3.

1941. Aph. austr. R.T. Wade, P.P.R.S.N.S.W. 75 p. 78, pl. iii f. 3, tf. 6.

1920. Serolepis suevicus, E. Stolley, Palaeontogr. vol. lxiii. p. 76.

1928. S. suevicus, G.F. Oertle, p. 365, pl. xxxi. f. 7-8.

Aphnelepis australis, A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9, with drawings on pl. iii. figs. 1–4.]

Type. Nearly complete fish; Geol. Survey Museum, Sydney.

The type species, attaining a length of about 0·2. Length of head with opercular apparatus contained about one-and-a-half times in the maximum depth of the trunk, and somewhat less than one-quarter of the total length of the fish; the caudal pedicle one-third as deep as the abdominal region at its highest point, where the dorsal fin arises. Pelvic fins arising opposite the origin of the dorsal, and the latter completely in advance of the anal; dorsal rays about 14, anal rays 10 in number. Scales ornamented with coarse crimpings, which are slightly radiating and usually confined to the hinder half.

Form. & Loc. Upper Hawkesbury-Wianamatta Series: Talbralgar, New South Wales.

Not represented in the Collection.

A large variety of *Aphnelepis*, perhaps identical with *A. australis*, is also described and figured, *loc. cit.* pl. iii. fig. 5.

Genus **SERROLEPIS,** Quenstedt.

[Handb. Petrefakt. 1852, p. 207.]

An indefinable genus founded upon detached flank-scales. These scales much deeper than broad, with a straight narrow overlapped margin, a large peg-and-socket articulation, and no sharp inner keel; the exposed portion ornamented with transverse ridges, terminating in denticulations at the posterior border.

A fragment of jaw, exhibiting a close series of stout styliform teeth, is described by Dames as having been found in association with the scales (Palæont. Abhandl. vol. iv. 1888, p. 172, pl. xiii. fig. 8). It may possibly pertain to the same genus.

Serrolepis suevicus, Dames.

1852. *Serrolepis*, F. A. Quenstedt, Handb. Petrefakt. p. 207, pl. xvii. fig. 13.

1888. *Serrolepis suevicus*, W. Dames, Palæont. Abhandl. vol. iv. p. 171, pl. xiii. figs. 4–7 (? 8).

Type. Isolated scales; Tübingen University Museum.

The type species, known only by isolated scales, of which the largest measure about 0·015 in total depth, and are four times as deep as broad in their exposed portion. Posterior denticulations

large, extended forwards as short, acute ridges; anterior half of the scale smooth or marked with finer transverse ridges.

Form. & Loc. Upper Triassic (Lettenkohl): Würtemberg.

P. 7402. Two fragments of dolomite with scales and a thin tuberculated bone; Comburg, near Hall. One scale is smooth n its anterior half. *Purchased.*

Genus **PRISTISOMUS,** A. S. Woodward.

[Foss. Fishes Hawkesbury Series, Gosford (Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, 1890), p. 32.]

Trunk deeply fusiform. Marginal teeth large, styliform, and in close series. Fin-fulcra small. Paired fins moderately developed; dorsal and anal fins remote, not much extended, the former partly opposed to the latter; caudal fin robust, scarcely forked. Three or more series of the flank-scales vertically elongated; dorsal and ventral scales as broad as deep; a dorsal and ventral series of prominent, acuminate ridge-scales.

Pristisomus gracilis, A. S. Woodward.

1890. *Pristisomus gracilis,* A. S. Woodward, *op. cit.* p. 33, pl. v. fig. 1, pl. vi. fig. 1, pl. viii. fig. 1.

Type. Nearly complete fish; Geol. Survey Museum, Sydney.

The type species, attaining a length of about 0·12. Head with opercular apparatus occupying about one-quarter of the total length; trunk gracefully fusiform, the maximum depth contained more than two-and-a-half times in the total length of the fish. Dorsal and anal fins almost of equal size, much elevated, and with a relatively short base-line.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6275. Fish wanting paired fins. *By exchange,* 1890.

P. 6277. Slab showing another specimen associated with *P. crassus.* *By exchange,* 1890.

Pristisomus latus, A. S. Woodward.

1890. *Pristisomus latus,* A. S. Woodward, *op. cit.* p. 35, pl. v. figs. 2–4.

Type. Nearly complete fish; Geol. Survey Museum, Sydney.

A slightly larger species than the type, with somewhat deeper

Wade 1940; p. 212. (J. Proc. R. Soc. NSW, 73: 206-17)

1940. Pristisomus gracilis, R.T. Wade, J. Proc. R. Soc. N.S.W. 73, 213, ff. 3, 4, pl. xi. f. 3.

1914. Pristisomus latus, ~~A.S. Woodward~~ C.R. Eastman, Ann. Carnegie Mus. vol. ix. p. 148, pl. xxxii. fig. 2.
= P. gracilis, Wade 1940: 212

= P. gracilis, Wade
1940: 212

P. merlei, s.n. – Australoomus.

trunk and smaller head. Dorsal fin considerably longer than the anal and not remarkably elevated.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6274. Two imperfect fishes. *By exchange*, 1890.

Pristisomus crassus, A. S. Woodward.

1890. *Pristisomus crassus*, A. S. Woodward, *op. cit.* p. 36, pl. v. figs. 5–7.

Type. Nearly complete fish; Geol. Survey Museum, Sydney.

A species about as large as the foregoing, but with more robust and less deepened trunk. Head with opercular apparatus occupying at least one-quarter of the total length; maximum depth of trunk contained about three times in the total length of the fish. Dorsal fin considerably larger than the anal, as long as deep.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6276. Trunk showing dorsal and part of caudal fin.
By exchange, 1890.

P. 6277. Slab with nearly complete fish, associated with *P. gracilis*.
By exchange, 1890.

Genus **SARGODON,** Plieninger.

[Württ. Jahresh. vol. iii. 1847, p. 165.]

An indefinable genus known only by the external incisive teeth. The dental crown is sharply separated from the long, cylindrical or nearly quadrangular root, and is chisel-like in shape.

It seems probable that the fish possessing such teeth would also have tritoral teeth on the inner bones of the mouth. As originally suggested by Plieninger, it is, therefore, not unlikely that the small Rhætic teeth named *Psammodus orbicularis* (Meyer & Plieninger, Beitr. Pal. Württembergs, 1844, p. 117, pl. x. fig. 24), and others ascribed to *Sphærodus minimus* (*ibid.* p. 117, pl. x. fig. 23, named by Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, pp. 216, 300), truly belong to *Sargodon*. Similar tritoral teeth have been described from the Rhætic of Leicestershire (A. S. Woodward, Trans. Leicester Lit. & Phil. Soc., n. s. vol. i. pt. xi. 1889, p. 20), Somersetshire, and Gloucestershire (M. Browne, Rep. Brit. Assoc. 1891, p. 645), and some are preserved in the Collection from Aust Cliff, near Bristol (**P. 6069 a.** *Presented by F. Harford, Esq.*, 1889).

Sargodon tomicus, Plieninger.

1847. *Sargodon tomicus,* T. Plieninger, Württ. Jahresh. vol. iii. p. 165, pl. i. figs. 5–10.

1858. *Sargodon tomicus,* F. A. Quenstedt, Der Jura, p. 35, pl. ii. figs. 34, 35 (? figs. 36–38).

Type. Teeth; Stuttgart Museum.

The type species, known only by detached teeth, which sometimes measure 0·005 in the breadth and in the depth of the crown. Dental crown robust, arched from side to side and the concavity probably being innermost; cutting-edge smooth, usually obliquely truncated by wear. Root not much compressed, usually nearly quadrangular in section, but with a shallow median longitudinal groove on its supposed inner face.

Form. & Loc. Rhætic: Würtemberg, France, Italy and England.

41288. Tooth in bone-bed; Axminster. *Purchased,* 1869.

P. 7401. Three specimens; Aust Cliff, near Bristol. *History unknown.*

P. 3930. Fine tooth; Aust Cliff. *Enniskillen Coll.*

Genus **COLOBODUS,** Agassiz.

[Poiss. Foss. vol. ii. pt. ii. 1844, p. 237.]

Syn. *Asterodon,* G. von Münster, Beitr. Petrefakt. pt. iv. 1841, p. 140.
Omphalodus, H. von Meyer, Neues Jahrb. 1847, p. 574.
Nephrotus, H. von Meyer, Palæontogr. vol. i. 1851, p. 243.
Thelodus, E. E. Schmid, Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, 1861, p. 27 (in part).
Eupleurodus, G. Gürich, Zeitschr. deutsch. geol. Ges. vol. xxxvi. 1884, p. 142.
Dactylolepis, H. Kunisch, *ibid.* vol. xxxvii. 1885, p. 594.

An imperfectly definable genus, not yet satisfactorily distinguished from *Lepidotus.* The form and proportions of the head and trunk, dentition, squamation, and the situation of the fins seem to be as in *Lepidotus.* In most species, however, the teeth are mammillated and more or less striated, while their arrangement has not yet been definitely proved to agree with that in the last-named genus; the overlapped border of the flank-scales is of uniform width, and not produced at the angles; while the dorsal and anal fins seem to be relatively more elevated than in *Lepidotus,* with smaller and more regular fulcra. The gular plate has not been discovered.

The genus *Colobodus* was originally founded upon a fragment of dentition from the Muschelkalk of France, and the above state-

1861. Sargodon tomicus, C. Moore, Quart. Journ. Geol. Soc. vol. xvii. p. 498, pl. xv. fig. 1.

1876. Sargodon cuneus, J. Henry, Mém. Soc. d'Emulation du Doubs [4] vol x, p. 412, pl. ii, fg. 11.

1876. S. tomicus, J. Henry, p. 412, pl. ii. f. 10.

1876. Sargodon incisivus, J. Henry, ibid. p. 412, pl. ii. fig. 12.

1907. Sargodon tomicus, H. E. Sauvage, in P. Thiéry, Note sur l'Infra-lias de Provenchères-sur-Meuse (Haute-Marne), p. 12, pl. iii, figs. ~~15~~ 16–18. [4 teeth in series in jaw.]

1908. Sargodon tomicus, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont.), p. 12, text-figs. 7, 8. [Row of 4 associated teeth from Provenchères.]

1919. Sargodon tomicus, B. Peyer, Mitth. Badisch. Geol. Landesanst. vol. viii. p. 302, pl. xxxiv. figs. 6, 7. [Micro. structure of teeth.]

Syn. See S. F. Oertle 1928° p. 376.

477.—**Thomasset**, J. J. Étude histologique des dents chez un poisson fossile : *Sargodon tomicus*. Bul. soc. géol. Paris 25 1925 pp. 891–896 1 pl. xxxv, 1 fig.

1930. S. L. J. Thomasset, figs. 35-39, 51, 52, 60. f. 45a, b, 59b.

1938. S. L. Gustromsen,° p. 29, figs. 23-28 (histology good).

1937. S. L. A. Bonsi,° p. 630, pl. ii f. 3-8, iii. 3-4, vi. 1-3, t-f. 7-8. (other Italian refs).

Amended definition of Colobodus by E. Stolley, Palaeontogr. vol. lxiii (1920), p. 43. and placed in 'Colobodontidae' E. Andersson 1916 (see below Meridensia) & finally in the Catopterids, E. A. Stensio (see below 1921 p. 254.) see Perleididae p. 57.

Structure of teeth with figs, Gustromsen 1938° p. 11 ff. 9-18

G.F. Barrois.

1928. C. hogardi, p. 365.

1929. C. hogardi, Ann. Paléont. XVII. p. 105, pl. XII f. 25
— Muschelkalk: Lorraine.

For curious thick triangular tubes ascribed to Sholodus schmidi, see K. von Fritsch, Abh. naturf. Ges. Halle, no. 24 (1906), pl. VIII.

ment of the characters of the trunk is based on the assumption that the nearly complete specimens of fishes from the Tyrol and Italy, recorded below under the names of *C. ornatus* and *C. latus*, are generically identical with the unknown fish to which the first-discovered example of dentition belongs. The name *Colobodus* is here preferred to that of *Asterodon*, because it seems to have been universally employed and is adopted by Professor W. Dames in his memoir giving the first satisfactory account of the genus (Palæont. Abhandl. vol. iv. 1888, p. 153).

Colobodus hogardi, Agassiz.

1844. *Colobodus hogardi*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 237 244.

1852. *Colobodus hogardi*, P. Gervais, Zool. et Pal. Franç., Poiss., Explic. Planches, p. 13, pl. lxxvii. fig. 15.

1853. *Colobodus hogardi*, C. G. Giebel, Zeitschr. naturw. Vereins Halle, vol. ii. p. 325.

1888. *Colobodus hogardi*, W. Dames, Palæont. Abhandl. vol. iv. p. 159.

Type. Fragment of dentition; Strassburg Museum.

The type species, known only by portions of dentition. Teeth crowded and thus of irregular polygonal form, with feebly striated crown and an apical tubercle not surrounded by an annular indent.

The type specimen was obtained from the Muschelkalk of Lunéville.

Form. & Loc. Upper Muschelkalk: Lunéville, France. Lettenkohl: Würtemberg.

Not represented in the Collection.

Colobodus frequens, Dames.

1837. *Gyrolepis albertii*, H. B. Geinitz, Beitr. Kennt. Thüring. Muschelkalkgeb. p. 21, pl. iii. figs. 3 *a*, *b* (*errore*).

1844. Scales described and figured by Meyer and Plieninger, Beitr. Palæont. Württembergs, p. 84, pl. xi. figs. 21–23, 25.

1851. Scales described and figured by H. von Meyer, Palæontogr. vol. i. pp. 200, 248, pl. xxix. figs. 2, 4, 5, 10, 11, 14–16, 18–21, 23, 27–29 (? figs. 3, 6), pl. xxxi. figs. 35–41.

1852. *Gyrolepis albertii*, F. A. Quenstedt (*errore*), Handb. Petrefakt. p. 206, pl. xvii. figs. 6, 7, 12 (? fig. 8).

1861. *Tholodus*[1] *minutus*, E. E. Schmid, Nova Acta Acad. Cæs. Leop.-

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[1] The genus *Tholodus* was originally founded by H. von Meyer on a fragment of dentition from the Muschelkalk of Upper Silesia, which may be reptilian. The type species is *T. schmidi* (H. von Meyer, in Schmid & Schleiden, Geogn. Verhält. Saalthals Jena (1846), p. 37, and Palæontogr. vol. i. (1849), p. 199, pl. xxxi. figs. 27, 28). See B. Peyer 1939, Palaeontogr. Stuttgart. 90 A. p. 1. 45, 46.

Car. vol. xxix. no. 9, p. 26, pl. iv. figs. 14, 15. [Fragment of dentition.]

1861. *Sphærodus globatus*, E. E. Schmid, *ibid.* p. 32, pl. iv. fig. 11.

1861. *Thelodus lævis*, E. E. Schmid, *ibid.* p. 29, pl. iv. figs. 27–29.

1864. *Lepidotus giebeli*, F. von Alberti, Ueberblick Trias, p. 210.

1865. *Colobodus varius*, H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien, pp. 67, 120 (*errore*).

1865. *Gyrolepis albertii*, H. Eck, *ibid.* pp. 71, 110, 122 (*errore*).

1872. *Colol odus varius*, H. Eck, Rüdersdorf u. Umgegend, pp. 94, 118 (*errore*).

1872. *Gyrolepis albertii*, H. Eck, *ibid.* pp. 101, 118 (*errore*).

1880. *Colobodus varius*, T. C. Winkler, Archiv. Mus. Teyler, vol. v. p. 126, pl. vii. fig. 27 (*errore*).

1880. *Tetragonolepis triasicus*, T. C. Winkler, *ibid.* p. 137, pl. viii. fig. 36. [Teeth; Würzburg University Museum.]

1888. *Colobodus frequens*, W. Dames, Palæont. Abhandl. vol. iv. p. 156, pl. xii. figs. 4, 5, pl. xvi.

1891. *Colobodus frequens*, G. Compter, Zeitschr. f. Naturw. vol. lxiv. p. 49, pl. i. figs. 7, 8.

Type. Portion of squamation; School of Mines, Berlin.

An imperfectly known species of moderate size. Scales smooth or ornamented with feeble, irregular, oblique striations, and the hinder margin with large, well-separated, long digitations. Teeth not crowded together, each with a conspicuously striated crown and an apical tubercle usually surrounded by a slight annular depression.

Form. & Loc. Muschelkalk and Lettenkohl: Germany, Lorraine.

P. 7403. Four scales; Muschelkalk, Bayreuth, Bavaria. *Purchased.*

P. 1042 a. Scale; Bayreuth. *Egerton Coll.*

Colobodus gogolinensis (Kunisch).

1885. *Dactylolepis gogolinensis*, H. Kunisch, Zeitschr. deutsch. geol. Ges. vol. xxxvii. p. 588, pl. xxiv.

1888. *Colobodus gogolinensis*, W. Dames, Palæont. Abhandl. vol. iv. p. 158.

Type. Anterior portion of fish; University Museum, Breslau.

An imperfectly known species, with squamation closely resembling that of *C. frequens*, and the lower marginal teeth relatively more slender than in the last-named species. Scales smooth, the hinder margin with large, flattened, long digitations, truncated at the extremity and only separated by shallow grooves.

Form. & Loc. Lower Muschelkalk: Upper Silesia.

Not represented in the Collection.

1859. Cobodus frequens, G. Cornay, Ann. Paleont. xvii. p. 105, pl. ii. fig. 13, pl. iii. f. 35.

1854. C. cf. varius Banza Rulla p. 103 pl. iii. f. 2. Trias: Spain.

1896. Dactylolepis gogolinensis, H. Scupin, Archiv f. Naturgesch. vol. i. p. 165 [structure of scale].

1901 E. Philippi & F. Frech, Lethaea Palaeozoica, p.

C. cf. varius T. Barja Rullan 1954 p. 100 pl 3 f. 1
(Spain)

1920. Colobodus maximus, E. Stolley, Palaeontogr. vol. lxiii. p. 30, pl. x. fig. 2, pl. xi. figs. 1–3.

1921. Colobodus maximus, E. A. Stensiö, 'Triassic Fishes Spitzbergen' pt. 1, (1921) p. 269, t-f. 86, 87.
See also C. praemaximus p. 76.

1929. C. maximus, G. Conroy, Ann. Palaeont. xvii. p. 104, pl. xii. f. 12-14, 26-28.

1931. C. cf. maximus, G. De Stefano, Pal. Ital. xxxii (n.s. ii) p. 30 fig. 7. (Somaliland).

1951. C. sp. T. Orvig Ark. f. Zool (2) 2 fig. 4 (Microst.)

Colobodus varius, Giebel.

1848. *Colobodus varius,* C. G. Giebel, Neues Jahrb. p. 150, pl. ii. figs. 1–6 (in part).
1848. *Gyrolepis albertii,* C. G. Giebel, *ibid.* p. 152 (*errore*).
1848. *Colobodus varius,* C. G. Giebel, Fauna d. Vorw., Fische, p. 181 (in part).
1888. *Colobodus varius,* W. Dames, Palæont. Abhandl. vol. iv. p. 160, pl. xiv. fig. 2.

Type. Fragment of dentition; School of Mines, Freiberg, Saxony.

A species known only from fragments of dentition and detached scales. Teeth irregularly rounded, not crowded together, the crown of each conspicuously striated and with an apical tubercle surrounded by a slight annular depression. Scales ornamented with numerous and prominent oblique ridges terminating at the hinder margin in irregularly-produced and attenuated digitations.

Form. & Loc. Lower Muschelkalk: Germany.

P. 1042. Two scales; Bayreuth, Bavaria. *Egerton Coll.*

P. 4625. Scale; Bayreuth. *Enniskillen Coll.*

P. 7404. Coarsely-marked imperfect scale, either of this species or *C. maximus*; Weimar.
Presented by C. Westendarp, Esq., 1884.

Colobodus maximus, Dames.

1847. *Pycnodus triasicus,* H. von Meyer, Neues Jahrb. p. 574 (name only).
1847. *Pycnodus splendens,* H. von Meyer, *ibid.* p. 574 (name only).
1849. *Pycnodus triasicus,* H. von Meyer, Palæontogr. vol. i. p. 237, pl. xxix. figs. 39, 40, 42–48. [Teeth.]
1849. *Pycnodus splendens,* H. von Meyer, *ibid.* p. 239, pl. xxix. fig. 41. [Teeth.]
1852. *Gyrolepis maximus,* F. A. Quenstedt (*errore*), Handb. Petrefakt. p. 206, pl. xvii. fig. 14. [Scale; Tübingen University Museum.]
1857. *Gyrodus picardi,* C. Chop, Zeitschr. gesammt. Naturw. vol. ix. p. 130, pl. iv. fig. 5. [Teeth.]
1861. *Thelodus inflatus,* E. E. Schmid, Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9, p. 28, pl. iv. figs. 23–26.
1861. *Sphærodus compressus,* E. E. Schmid, *ibid.* p. 31, pl. iv. figs. 1–5.
1861. *Sphærodus rotundatus,* E. E. Schmid, *ibid.* p. 32, pl. iv. figs. 6–10.
1865. *Gyrolepis albertii,* H. Eck (*errore*), Form. bunt. Sandst. u. Muschelk. Oberschlesien, p. 122.
1885. *Gyrolepis maximus,* F. A. Quenstedt (*errore*), Handb. Petrefakt. ed. 3, p. 322, fig. 102, pl. xxv. fig. 15.
1888. *Colobodus maximus,* W. Dames, Palæont. Abhandl. vol. iv. p. 162 pl. xii. fig. 3 (& ? fig. 2), pl. xiii. fig. 2, pl. xiv. fig. 1, and (?) pl. xvi *a*. fig. 9.

Type. Imperfect head and anterior scales; University Geological Museum, Göttingen.

A large species known only by portions of the head and squamation. External head-bones ornamented with closely arranged rugæ; teeth resembling those of *C. varius*. Scales differing little from those of *C. varius*, but wanting the upper and lower almost free transverse ridges and having all the other ridges stouter than in the last-named species.

Form. & Loc. Upper Muschelkalk and Lettenkohl: Germany.

Not represented in the Collection.

Colobodus chorzowensis (H. von Meyer).

1847. *Omphalodus chorzowiensis*, H. von Meyer, Neues Jahrb. p. 574.
1848. *Colobodus* (?) *chorzowiensis*, C. G. Giebel, Fauna d. Vorw., Fische, p. 466.
1851. *Nephrotus chorzowensis*, H. von Meyer, Palæontogr. vol. i. p. 242, pl. xxviii. fig. 20. (Also scales described and figured *ibid.* pp. 251, 252, pl. xxix. figs. 30–37.)
1865. *Colobodus chorzowensis*, H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien, p. 66.
1865. *Pleurolepis silesiacus*, H. Eck, *ibid.* p. 71. [Scales.]
1884. *Eupleurodus sulcatus*, G. Gürich, Zeitschr. deutsch. geol. Ges. vol. xxxvi. p. 142, fig. 5. [Fragment of dentition; coll. of Herr Möcke, Kattowitz.]
1888. *Colobodus chorzowensis*, W. Dames, Palæont. Abhandl. vol. iv. p. 167, pl. xvi *a*. figs. 1–8.

Type. Fragment of dentition.

A species known only from fragments of dentition and detached scales. Teeth oval or irregularly rounded, not crowded together, the crown of each nearly smooth and with a large apical tubercle. Scales ornamented with a few very large oblique ridges, which do not bifurcate and often extend directly from the anterior to the posterior border.

Form. & Loc. Lower Muschelkalk: Upper Silesia.

Not represented in the Collection.

Colobodus ornatus (Agassiz).

1832. *Lepidotes ornatus*, L. Agassiz, Neues Jahrb. p. 145.
1833–37. *Lepidotus ornatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 9, 249, pl. xxxii.
(?) 1844. *Lepidotus speciosus*, L. Agassiz (*ex* Münster, MS.), *ibid.* p. 266, pl. xxxiv *a*. figs. 5–7. [Imperfect tail; Palæontological Museum, Munich.]

1896. Colobodus chorzowiensis, H. Sauvin, Archiv f. Naturgesch. vol. i, p. 164, pl. ix. fig. 10.

1903. Nephrotus chorzowiensis, H. Sauvin, Zeitschr. deutsch. geol. Ges. vol. 7v.

1928. Colobodus (cfr. chorzowensis), G. T. Oertle, p. 368 pl. xxxi f. 1-2.

1896. Lepidotus speciosus, H. Sauvin, Archiv für Naturgeschichte, vol. i, p. 160, pl. ix. fig. 6 [structure of scale].

1855-6. *L. acutirostris*. O.G. Costa, Ill. foss. Ital. p.7, pl.ii. f.1.

1896, C.O. de Bosniaski Pal. Hub. I p.187 pl. 5 figs.

1905. *Colobodus ornatus*, K. J. Kramberger Pal. ~~Ungar~~ Österr.-Ungarns, xviii. p.199, pl. x f.1, 2-8 (xvii (1)) (pl. xi (v) f. 1-4) [Ind. *C. latus*]. (= ? *C. elongatus*)

1920. *Paralepidotus ornatus*, E. Stolley, Palaeontogr. vol. lxiii. p. 41. [Type of genus *Paralepidotus*, E. Stolley, loc. cit. p. 41.]

1920. *Colobodus ornatus*, G. De Alessandri, Atti Soc. Ital. Sci. Nat. vol lix. p. 86, pl. iii. text-fig. A.

1920. ~~*Colobodus ornatus*, G. de Alessandri, Atti~~ Soc

1929. ~~Paralepidotus~~ *Paralepidotus ornatus*, G. Corroy, Ann. Paléont. xvii. p. 106, pl. iv. f. 8.

1938 *Paralepidotus* sp. B. Peyer, p. 356. [illegible]

1938. " Gottsmen p. 25, ff. 19-20 (Stim. of Trias)

1937. *Paralepidotus ornatus*, A. Bonì p. 603, i, 1; iv, 1; vi. f. 10. (4-5

1948. " " E. Kuhn Schlo. Geol. Helv. 40 p. 384, 3 figs. pl. 7.

1953. of *Paralepidotus* dentition of L. Trias Geol. Dolomites Fiori B. Accordi, 1953 Boll. Serv. Ferrare N.S. I p. 185 pl.

Paralepidotus! *antiquus* sp. n. *mazodani* sp. n. *fabianus*, Permian N. Trias B. Accordi 1950, Mem. Ist. Geol. Min. Univ. Padova 19 pp. 16-28 figs. figs. [Is R. *comensis*?]

1850. *Lepidotus acutirostris*, O. G. Costa, Atti Accad. Pontan. vol. v. p. 301, pl. viii. fig. 1 A.
1850. *Lepidotus gigas*, O. G. Costa (*errore*), *ibid.* p. 308, pl. viii. fig. 3.
1857. *Lepidotus? spinifer*, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia, p. 421. [Fragment; Milan Museum.]
1862. *Lepidotus acutirostris*, O. G. Costa, Atti R. Accad. Sci. Napoli, vol. vi. Append. pp. 17, 44, pl. vii. fig. 3.
1862. *Lepidotus* sp., O. G. Costa, *ibid.* pp. 20, 42, pl. ii.
1862. *Semionotus* sp., O. G. Costa, *ibid.* p. 43, pl. iii.
1862. *Semionotus curtulus*, O. G. Costa, *ibid.* pp. 20, 43, pl. iv.
1862. *Urocomus picenus*, O. G. Costa (*errore*), *ibid.* pp. 27, 43, pl. vi. fig. 1 *a* A.
1866. *Lepidotus ornatus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. p. 313, pl. ii.
1866. *Lepidotus obesus*, O. G. Costa, Atti R. Accad. Sci. Napoli, vol. iii. no. 12, p. 4, pls. i., ii.
1889. *Semionotus spinifer*, W. Deecke, Palæontogr. vol. xxxv. p. 136.
1891. *Lepidotus triumplinorum*, A. de Zigno, Mem. R. Accad. Lincei, [4] vol. vii. p. 6, pl. i. [Nearly complete fish; University of Padua.]
1892. *Lepidotus* (*Colobodus?*) *ornatus*, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, p. 24.

Type. Portions of fishes; Stuttgart Museum.

A species attaining a length of about 0·5. Trunk deeply fusiform, its maximum depth much greater than the length of the head with opercular apparatus, which occupies nearly one-quarter of the total length of the fish. External bones finely ornamented with tuberculations; teeth smooth, not closely adpressed, those within the mouth oval or rounded. Pelvic fins arising opposite the origin of the dorsal fin, and much nearer to the anal than to the pectorals; dorsal fin with about 24 rays, the anal less than half as large and opposed to its hinder portion. Scales smooth, but those of the flanks, except in the hinder half of the caudal region, with long and conspicuous posterior digitations; principal flank-scales scarcely deeper than broad.

Form. & Loc. Upper Triassic: Tyrol; Italy.

Mus Schlotheim: Lorraine.

13444. Imperfect hinder portion of head with anterior portion of trunk; Seefeld, Tyrol. The head and opercular bones, though very fragmentary, exhibit the characteristic tuberculations; some of the circumorbital bones are distinct, and the large upwardly-directed anterior process of the suboperculum is conspicuous. There are traces of large postclavicular scales; and there are prominent fulcra on the anterior ray of the pectoral fin. *Purchased*, 1836.

P. 1540, P. 4657. A somewhat smaller but nearly similar specimen, partly in counterpart; Seefeld.
Egerton and Enniskillen Colls.

21375. Imperfect trunk, displaying the squamation and part of the tuberculated operculum; Seefeld. Part of a postclavicular scale is highly ornamented. *Purchased*, 1847.

P. 1539. More imperfect portion of trunk; Seefeld. *Egerton Coll.*

P. 3622. Middle portion of deepened trunk; Seefeld.
Enniskillen Coll.

The following specimen may represent the young of *C. ornatus*:—

P. 4706. Fragment of head and trunk of a very small fish, with extremely conspicuous ornamentation on the plan of that of *C. ornatus*; Seefeld. The fossil is associated with an imperfect *Pholidophorus*-like fish. *Enniskillen Coll.*

Colobodus latus (Agassiz).

1833. *Dapedius altivelis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 8 (undefined).
1833–37. *Semionotus latus*, L. Agassiz, *ibid.* pp. 8, 227, pl. xxvii.
1843. *Semionotus pentlandi*, Sir P. Egerton, Proc. Geol. Soc. vol. iv. p. 183. [Caudal region; British Museum.]
(?) 1843. *Semionotus pustulifer*, Sir P. Egerton, *ibid.* p. 183. [Fragment of opercular apparatus and squamation; British Museum.]
1844. *Lepidotus parvulus*, L. Agassiz (*ex* Münster, MS.), *tom. cit.* p. 267, pl. xxxiv *a.* figs. 8, 9. [Imperfect fish; Palæontological Museum, Munich.]
1850. *Lepidotus notopterus*, O. G. Costa (*errore*), Atti Accad. Pontan. vol. v. pp. 303, 426, pl. viii. figs. 1 B, 4.
1850. *Semionotus curtulus*, O. G. Costa, *ibid.* vol. v. p. 294, pl. vii. fig. 6, pl. viii. fig. 2.
1853–64. *Lepidotus acutirostris*, O. G. Costa, *ibid.* vol. viii. pp. 76, 193, pl. ix. fig. 1, and Ittiol. Foss. Ital. p. 7, pl. ii. fig. 1.
1853–64. *Semionotus curtulus*, O. G. Costa, *ibid.* vol. viii. pp. 78, 194, pl. xi. fig. 1, and Ittiol. Foss. Ital. p. 25, pl. iii. fig. 1.
1861. *Semionotus latus*, O. Fraas, Württ. Jahresh. vol. xvii. p. 85.
1862. *Semionotus curtulus*, O. G. Costa, Atti R. Accad. Sci. Napoli, Append. p. 43, pl. v. fig. 1.
1864. *Semionotus curtulus*, O. G. Costa, Atti Istit. Inc. Sci. Nat. Napoli, [2] vol. i. p. 238, pl. iii. fig. 1.
1866. *Semionotus latus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. p. 319, pl. iii. fig. 5, pl. iv.

P. 10911

P. 10944

P. 10282-5, P. 10944-7, P. 11097, Hallein.

? Seminotis carinulatus n.s. O. G. Costa Ittiol. foss. Ital. 860 (1873.?) p. 49, pl. V. f. 1. (Italy near Naples). See also p. 62a (T 257)

L. pagodzonii = *C. latus*, acc. to G. De Alessandri, 1910.
C. latus = *C. ornatus* acc. to K. G.-Krambeger 1905 s.v.

1896. Col. lat. F. Barsani Pal. Ital. i, p. 92 as Fig.
1896. *Semionotus latus*, H. Scalpin, Archiv f. Naturgeschichte, vol. i. p. 168, pl. x. f. 3 [structure of scale].
1910. *Colobodus latus*, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 81, pl. v. fig. 1.
1920. *Colob. latus*, G. De Alessandri, Atti Soc. Ital. Sci. Nat. vol. lix. p. 101.

Colobodus africanus (Traquair), Traquair 1910, Q. J. G. S. 66: 249-51, Karr
Nyasaland (P. 11242-45).

Colobodus angulatus n. s. G. F. Oertg. 1928, p. 368,
pl. xxxi f. 6 — Rhaet. BB.; Tübingen.

Colobodus elongatus. n. c. K. Gorjanović-Krambergr
1905, Beitr. Pal. Österr.-Ungarns VIII. p. 208, pl. xix (iii). f. 1. tf. 9-11
Fish, U. Trias, Hallein, N. Austria. ? pl. xxi f. 1, 4.
? P. 11096.

1891. *Lepidotus ragazzoni*, A. de Zigno, Mem. R. Accad. Lincei, [4] vol. vii. p. 8, pl. ii. figs. 1, 2. [Nearly complete fish; University of Padua.]

1892. *Lepidotus* (*Colobodus*?) *latus*, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, p. 24.

Type. Portion of fish; Palæontological Museum, Munich.

A species attaining a length of about 0·35; general proportions, teeth, and external ornamentation of bones as in *C. ornatus*. Scales smooth and without serrations, except in the lower half of the abdominal flank, where they are often marked with feeble oblique striations and pectinated at the hinder margin; principal flank-scales considerably deeper than broad.

Form. & Loc. Upper Triassic: Tyrol; Italy.

21377. Portion of trunk, with fragment of head; Seefeld, Tyrol.
Purchased, 1847.

P. 1104, P. 3622 a. Imperfect head and abdominal region of smaller fish, in counterpart; Seefeld.
Egerton and Enniskillen Colls.

P. 604. Caudal region, showing anal and caudal fins, described by Egerton (*loc. cit.* 1843) as the type specimen of *Semionotus pentlandi*; Giffoni, province of Salerno, Italy.
Egerton Coll.

P. 602. Very imperfect fragment of opercular apparatus and flank-squamation probably pertaining to this species, described by Egerton (*loc. cit.* 1843) as the type specimen of *Semionotus pustulifer*; Giffoni. *Egerton Coll.*

P. 1549. Portion of trunk of a small fish, perhaps young of this species; Seefeld. The principal flank-scales are extremely finely serrated on their hinder margin, and the specimen bears the MS. name of *Semionotus tenuiserratus*, Egerton.
Egerton Coll.

Scales of an undetermined species of *Colobodus* have been recorded from the Rhætic of Aust Cliff, near Bristol (M. Browne, Rep. Brit. Assoc. 1891, p. 645), and the undermentioned scale appears to be referable to this genus:—

P. 7405. Rhombic scale 0·007 in depth, with a few superficial pittings tending to oblique elongation and at least four long slender digitations obliquely directed downwards at its postero-inferior angle; Rhætic Bone-bed, Aust Cliff.
Egerton Coll.

The following species have also been determined upon fragmentary evidence, but there are no examples in the Collection :—

Colobodus bronni : *Asterodon bronnii*, G. von Münster, Beitr. Petrefakt. pt. iv. (1841), p. 140, pl. xvi. fig.14 ; W. Dames, Palæont. Abhandl. vol. iv. (1888), p. 153 : *Colobodus varius*, C. G. Giebel, Neues Jahrb. 1848, p. 152 (*errore*).—St. Cassian Beds ; Tyrol. [Fragment of dentition ; Palæontological Museum, Munich.] The so-called *Gyrolepis biplicatus* (Münster, *op. cit.* p. 140, pl. xvi. fig. 15) may perhaps be the scale of this species.

Colobodus scutatus, P. Gervais, Zool. et Pal. Franç. (1852), Poiss., Explic. Planches, p. 13, pl. lxxvii. fig. 16 ; W. Dames, Palæont. Abhandl. vol. iv. (1888), p. 166.—Muschelkalk ; Moselle, France.

Colobodus sibiricus, A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. iv. (1889), p. 107 : *Palæoniscus sibiricus*, J. V. Rohon, Mém. Acad. Imp. Sci. St.-Pétersbourg, [7] vol. xxxvi. no. 13 (1889), p. 12, pl. ii. figs. 21, 22, 28.—Triassic (?) : Kubekowa, Upper Jenissei, Siberia. [Scales ; Imperial Academy of Sciences, St. Petersburg.]

The fossils described under the following names may be fragments of the dentary bone of *Colobodus*, but they are as yet indeterminable :—

Charitodon glabridens, E. E. Schmid, Nova Acta Acad. Cæs. Leop.-Car. vol. xxix. no. 9 (1861), p. 30, pl. i. fig. 41.—Muschelkalk ; Jena.

Charitodon granulosus, E. E. Schmid, *ibid.* p. 30, pl. i. fig. 42.—Ibid.

Charitodon procerus, H. Eck, Form. bunt. Sandst. u. Muschelk. Oberschlesien (1865), p. 70, pl. ii. fig. 4.—Lower Muschelkalk ; (?) Chorzow.

Charitodon tschudii, H. von Meyer, Palæontogr. vol. i. (1849), p. 205, pl. xxxi. figs. 22, 23 : *Charitosaurus tschudii*, H. von Meyer, Neues Jahrb. 1838, p. 415. Figures also by Buttner, Rudera diluvii testes (1710), pl. x. fig. 6, and Knorr & Walch, Verstein. Suppl. pl. viii. fig. 2.—Muschelkalk ; Querfurt and Esperstädt, Saxony.

Hemilopas mentzeli, H. von Meyer, Neues Jahrb. 1847, p. 575, and *loc. cit.* (1849), p. 236, pl. xxviii. figs. 16, 17.—Muschelkalk ; Upper Silesia.

Dep 5-7 (Perledo)

Colobodus altilepis, A. S. Woodward, Bull. Geol. Inst. Upsala, vol. xi (1912), p. 296, pl. xiv. fig. 7. — Lower Trias; Sassen Bay, Spitzbergen. [Imperfect fish; Geol. Mus. Univ. Upsala.]

Colobodus miliarum, J. Henry, Mém. Soc. d'Emulat. Doubs [4] vol. x (1876), p. 413, pl. ii. fig. 15. — Rhætic; Beure, L. [Tooth.]

Colobodus bassanii, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 74, pl. ii. fig. 4, pl. iii. figs. 1–3. — Kuper; Bezano, Lombardy; also Meride, Lake Lugano. [Cremilepis bassanii, E. Stolley, Palaeontogr. vol. lxiii (1920), p. 44. Colobodus bassanii, E. A. Stensiö, Triassic Fishes from Spitzbergen pt. i. (1921), p. 268, fig. 85. Eggycolobodus leticus, v. g. 15.

Colobodus veronzioi, G. D'Erasmo, Atti R. Accad. Sci. Napoli [2] vol. xvi (1914), no. 1, p. 7, text-fig. 3. = Heterolepidotus (?) [illegible]idii veronzii, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 105, pl. vi. fig. 2. — Trias; Perledo and Pellezzano, Italy. [Nearly complete fish; Bergamo 1837 c. fig. 18 p. 60.

Colobodus königi, E. Stolley, Palaeontogr. vol. lxiii. p. 34, pl. xi. fig. 5. — U. Muschelkalk; Nussloch, near Heidelberg. [Nearly complete fish; H. König Coll.]

Colobodus praemaximus, s.n. G. Corroy, 1929, Ann. Paléont. xvii. p. 102, text-figs 6, 6, pl. x. figs 1–3. — Werfenian (Trias): Baccarat Lorraine. ! Fish s. fins & tail ? ? C. maximus

Meridensia meridensis, E. Andersson, Bull. Geol. Inst. Univ. Upsala, vol. xv (1916), no. 2, p. 13. J. Brough 1939°, p. 6, fig. 1 pls.

Meridensia gibba s.n. Brough 1939°, p. 11, figs 1 pls. Trias; Lombardy. Imp. Fish: B. M.

× Colobodus (?) triasicus, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 84. pl. ii. fig. 5.

Both named Pycnodus priscus by J. Henry, Mém. Soc. d'Émulat. Doubs [4] vol. x (1876), p. 411, pl. ii. fig. 9. - Rhétic.

Archaeolepidotus gen. nov. Type A. leonardii Sp. L. Trias, N. Italy B. Accordi. Mem. Ist. ged. min. Univ. Padua 19 1958 p. 8 Tf. 1-3 pl. i f. 1, 2, 4, 5, iii f. 3.; 1956 J. Paleont. 30 p. 345 pl. 46.

? Is this Lepidotus Asso 1801 An. Cien. nat. IV. 38.

Skuchine & Leich, S. Thomas et, 1930, figs 45 ≈, 53 ≈. Fossil fishes Q.S. Woodward 1942 A. M. Nat. Hist. (11) 9. p. 506. Tf. 1.

Lemoreanum, Reuyer 1941. Bull. Rev. 16 p. 235 Tf. 1. 1948. Phil Trans. 233 B: 307 f. 10-13: Holmgren Skenio see p. 86 Head. de chaseneux 1943. L. Bertin 1958 Bull. Soc. geol. France (6) T. 10 91, 3 49-51, 7 figs. Bathonian: Morocco. (L. sp.).

Bialepidotus shingyiensis g. et s. n. T.-T. Su, 1959 Vert. Palasiat. 3, 4. 209 Tf. 2 pl. ii f. 1, 2. Inst. geol. Acad. Sinica. M. Trias, Kuleichan Prov. S.W. China.

It is not improbable that the following species is also correctly placed here :—

Lepidotus triasicus, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. (1886), p. 38.—Keuper; Besano, Lombardy. [Hinder portion of trunk; Milan Museum.]

To this genus may also perhaps be referred the detached teeth from the Keuper of Tübingen, Würtemberg, bearing the undefined name of *Pycnodus priscus* (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 199), and others described as *Sphærodus annularis* (L. Agassiz, *ibid.* p. 211, pl. lxxiii. figs. 95–100). The origin of the latter is uncertain.

The indefinable genus *Cenchrodus* (H. von Meyer, Neues Jahrb. 1847, p. 574), founded upon a dentigerous bone, may perhaps be related to *Colobodus*, but its affinities are uncertain. Two species are recognized from the Muschelkalk of Upper Silesia, namely, *Cenchrodus goepperti* and *C. ottoi* (H. von Meyer, *loc. cit.* p. 574, and Palæontogr. vol. i. 1851, pp. 243–247, pl. xxviii. figs. 18, 19).

Genus **LEPIDOTUS**, Agassiz.

[Neues Jahrb. 1832, p. 145 (*Lepidotes*), and Poiss. Foss. vol. ii. pt. i. 1833, pp. 8, 233.]

Syn. *Lepidosaurus*, H. von Meyer, Palæologica, 1832, p. 208.
Sphærodus, L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1833, p. 15 (in part).
Scrobodus, G. von Münster, Neues Jahrb. 1842, p. 38.
Plesiodus, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 632.
Prolepidotus, R. Michael, Zeitschr. deutsch. geol. Ges. vol. xlv. 1893, p. 729.

Trunk fusiform and only moderately compressed. Marginal teeth robust, styliform; inner teeth stouter, often tritoral but smooth; opercular apparatus well developed, with a narrow arched preoperculum, but with few branchiostegal rays, and the gular plate wanting. Ribs ossified. Fin-fulcra very large, present on all the fins, biserial. Paired fins small; dorsal and anal fins short and deep, the former opposed to the space between the latter and the pelvic fins; caudal fin slightly forked. Scales very robust, smooth or feebly ornamented; flank-scales not much deeper than broad, with their wide overlapped margin produced forwards at the superior and inferior angles; scales of the ventral aspect nearly as deep as broad; dorsal and ventral ridge-scales usually inconspicuous.

The chondrocranium in *Lepidotus* is well ossified, and the basi cranial axis is straight. The basioccipital exhibits on its posterior face a very deep conical fossa for the notochord; and the inferior aspect of the bone is marked by a broad longitudinal groove, with a flattened rim on each margin, probably indicating the backward extension of the basicranial canal (for the recti muscles of the eye) as far as the occiput. In one example of *L. latifrons* (no. P. 6841) there is also some appearance of one vertebral ring being fused with the basioccipital on its hinder face. The exoccipital forms a considerable part of the lateral wall of the brain-case, and is perforated as usual by a large transversely-oval foramen for the exit of the vagus nerve. The pro-otic has a still larger extent than the exoccipital, and exhibits a deep oblique notch at its anterior margin for the passage of the fifth nerve. The characters of the interorbital septum, pterotic and opisthotic bones are still unknown; and of the ethmoids it can only be said that they surround a pair of long closed canals for the passage of the olfactory nerves. The membrane bones of the cranial roof form a continuous shield, but do not extend backwards quite so far as the occipital border. There are two principal pairs of bones, the short parietals behind and the longer frontals forwards, not bilaterally symmetrical, but uniting in all directions by irregularly angulated sutures, which vary in different species. More anteriorly there would be nasals, but these are not satisfactorily known. The long and narrow squamosal element on each side reaches as far forwards as the anterior extremity of the parietals, but not so far backwards as the hinder margin of these bones. It is considerably overlapped by the supratemporal series of plates, and on the inner aspect there is an undetermined amount of connection with some of the ossified otic elements. Its surface for articulation with the upper end of the hyomandibular is clear, and a triangular walled area at the hinder end of its inner surface denotes the boundaries of the small temporal fossa. Postfrontal and prefrontal membrane bones are not differentiated from the circumorbital ring, and the cheek-plates are irregularly subdivided, being often different even on the two sides of the same head. The general plan of the cheek-plates, however, is distinct, there being a complete circumorbital ring, a semicircle of suborbitals, and a short deep series of preorbitals flanking the ethmoid region. The maxilla is a very delicate bone, deepest behind, tapering forwards, and terminating in front in an inwardly-directed process for articulation with the palatine; its oral margin is provided with a series of styliform teeth. The premaxilla is a smaller, stouter bone, also with a single series of styliform teeth, and bearing at its inner extremity a very large

On epiotics, &c., see A. S. Woodward, Zool. Fishes Weald. & Purb. Form. (Pal. Soc. 1915), 1916, p. 38, 39, text-figs. 15, 16.

Neurocranium ab. Rayner 1948 Ph. Tr. R.S. 233B p. 307 figs 10-13.

Neurocranium (from Bartan? Morocco) L. Beltan 1957 Bull. Soc. géol. France (6) 7 1091-1106, figs. 49-57 pls. xlix-li.

L. sp. Jurassic. Portugal F. Gonçalves 1957 Bol. Mus. Lab. Min. Geol. Univ. Lisboa 2 1: 3 pl. i

ascending process which fits into a groove on the inferior aspect of the frontal bones. The base of the cranium is sheathed by a great parasphenoid bone and by the coalesced dentigerous vomers. The parasphenoid is narrowest at the origin of the large fan-shaped basipterygoid processes, expanding much behind and exhibiting a deep cleft in its hinder margin. It bears no teeth and is pierced mesially by a foramen for the passage of the internal carotids, which appears single on the lower face, but double on emerging above; the superior or attached face also shows the deep excavation forming the floor of the basicranial canal. The vomer is a stout thickened bone with crushing teeth, showing cavities in which the germ-teeth are formed; and the dentigerous bones of the palato-pterygoid arcade, closely connected with the vomer in front, exhibit a similar thickening. The hyomandibular is an elongated, laterally compressed bone, with its long axis slightly bent at the origin of the process of support for the operculum. It is somewhat strengthened by longitudinal ridges on the outer face, and the surface for attachment with the cranium is much extended. The bone is not pierced by any foramen. The symplectic element remains unknown, but the hinder border of the quadrate exhibits an inner surface evidently for union with it. The quadrate is slender for a fish with so powerful a dentition, and in the fine example of *Lepidotus latifrons* from the Oxford Clay (no. P. 6841) this element is of much interest as exhibiting a very different degree of ossification on the two sides. The metapterygoid bone is also comparatively delicate, but it shows a broad facette on its upward and anteriorly directed process, which may have articulated with some lateral element of the cranium. The hinder portion of Meckel's cartilage is ossified as a robust articular bone, and to its outer face there is apposed a large plate, probably to be interpreted as angular. The coronoid region of the mandible is very deep, and the summit of the elevation is completed by a very small coronoid bone, shown in a Wealden specimen of *L. mantelli* (no. P. 6342). The dentary bone, very deep in the coronoid region, becomes much narrower in its tooth-bearing portion; and its anterior half curves rapidly inwards to meet its fellow of the opposite side in a somewhat deepened symphysis. To the inner side of the dentary bone the robust splenial is articulated by a roughened face, and it also enters the mandibular symphysis; whereas the dentary exhibits only one regular series of teeth, this element has several irregular series of a more tritoral character. The ceratohyal exhibits its ordinary hour-glass-shaped form, and is deepest behind. The hypohyals are a pair of very small triangular bones; and no evidence of an ossified glossohyal has hitherto been observed.

The teeth are hollow and the calcigerous tubes in the dentine radiate from the central cavity. The cap of enamel is thick, and when the germ of the successional tooth is first formed it lies in exactly the opposite direction to that of the functional tooth, thus making a revolution of 180° while the root of the old tooth is absorbed and it prepares to appear. The marginal teeth, forming a single series on the maxilla, premaxilla, and dentary, are comparatively small and prehensile; those within are more robust and form a tritoral pavement. The latter are arranged with more or less regularity on the coalesced vomers, the pterygo-palatine arcade, and the splenial. In the earlier species all the teeth exhibit comparatively elongated pedicles, while in the later and more specialized forms the inner teeth are fixed on very short bases.

The opercular apparatus is complete and there is a good series of branchiostegal rays, the uppermost very broad; but no indications of a gular plate have yet been discovered. The last-named fact is all the more remarkable, since in some of the other genera of Semionotidæ the gular plate is relatively large and robust. The preoperculum is a long narrow bone, exposed throughout its length and much bent forwards below. The operculum exhibits a sharp elevation on its inner face for articulation with the hyomandibular process; its upper border is overlapped by the supratemporal plates, and its lower border deeply overlaps the suboperculum. The latter element is almost sickle-shaped, with a very large upwardly-directed process at its antero-superior angle, and abruptly truncated in front for union with the large elongate-triangular interoperculum.

The branchial arches are delicate and have only been observed in a fragmentary state. The gill-filaments are shown in the Oxfordian species to have been supported by a series of long slender rods, apparently quadrate in section, and each serrated on one margin; the gill-rakers are small, stout, and pointed, tipped with enamel, more or less falciform, and arranged in well-spaced series.

The endoskeleton of the trunk is well ossified, but owing to the thickness of the squamation it is rarely seen and is as yet only imperfectly known. The notochord is persistent, and in the earlier and smaller species no ossifications have been observed in its sheath; but in the large Wealden, and perhaps also in the large Oxfordian, species there are distinct indications of ring-vertebræ, at least in the abdominal region. The rings are much deeper than broad, but in the few known specimens (*e. g.* nos. 2401, P. 1124, P. 6348 *c*) their precise characters are obscure, and it can only be stated that each ring appears to consist of four sectors, the lower pair bearing short processes for the support of the ribs. The right and left halves of

the neural arches in the abdominal region are separate and not anchylosed with the neural spine; the ribs are long and slender, apparently extending to the ventral border.

In the pectoral arch the clavicle is relatively much expanded, though pointed, below; and it tapers irregularly above where overlapped by the supraclavicle. Immediately behind the longitudinal bend in the element the outer surface is covered with a rugose thickening, marked with vermiculating rows of denticles of ganoine. The supraclavicle is narrow, about half as long as the clavicle, and firmly articulated at its thickened upper end with the small, almost club-shaped post-temporal. The basal bones of the pectoral fin are large and much elongated, slightly expanded at each end, and more than five in number. The pelvic fin-supports are unknown. Biserial fulcra are present on the anterior border both of the paired and median fins; and the supports of the dorsal and anal are much enlarged beneath them.

The supratemporal plates vary much in arrangement in different species of *Lepidotus*, but they always overlap both the cranial roof-bones and the most anterior dorsal scales. In *L. latifrons* there is one not quite symmetrical pair of outer plates, occupying the space between the operculum, squamosal, and parietal on each side; and there are three symmetrically arranged plates, no larger than ordinary scales, apposed to the hinder margin of the parietals. In *L. mantelli* the supratemporals are in three pairs, the two outer ones corresponding to the single outer pair in *L. latifrons*. In *L. elvensis*, as already described by Quenstedt, the supratemporal series consists of a single pair of large plates, as in *Amia*.

There is a series of postclavicular scales, but only two on each side are much enlarged. These two scales extend the whole depth of the flank, the uppermost being longest and narrowest. There are also three enlarged scales round the anus, which seems to have been mesially placed; their exposed portion is cycloidal, and the hinder margin usually serrated. Nearly all the other scales are in regular series, and those of the flank are united by a feeble peg-and-socket articulation; a single row of scales, however, at the base of the dorsal, anal, and caudal fins does not conform to the regular flank-series, but is directly related to the fin-rays and fulcra. All the flank-scales are deeply overlapping, and most of them exhibit a forward production both of the antero-superior and antero-inferior angle; in some of those of the foremost series the overlapped portion is wider than the exposed area. The dorsal and ventral ridge-scales are never much enlarged; they are inconspicuous in the more robust species, but appear as a serrated ridge on the back in those which are more laterally compressed.

The course of the sensory canals on the trunk can be traced by perforations and notches in the scales, which never produce a superficial ridge. There is one principal lateral line, as usual, and a second proceeds above on each side from the outer supratemporal to the origin of the dorsal fin, but apparently not beyond.

The species of *Lepidotus* are numerous, and many are only imperfectly known. The following synopsis of those described below shows the nature of some of the specific characters :—

I. Inner teeth on long pedicles, not much enlarged. Scales smooth.
  Parietals less than half as long as frontals, which are three times as long as broad and united by slightly wavy suture ; operculum two-thirds as broad as deep ; scales in part serrated..... *elvensis*, p. 84.
  Ditto, but median frontal suture more wavy, parietals longer, and fish more elongated *semiserratus*, p. 85.
  Parietals at least half as long as frontals, which meet in a nearly straight median suture; operculum two-thirds as broad as deep ; scales not serrated ..... *gallineki*, p. 87.
  Parietals half as long as frontals, which are twice as long as broad and united by deeply sinuous suture; operculum two-thirds as broad as deep ; principal flank-scales conspicuously denticulated ..... *latifrons*, p. 89.
  Parietals less than half as long as frontals, which are three times as long as broad and united by nearly straight median suture ; principal flank-scales conspicuously denticulated ..... *macrocheirus*, p. 90.
  Operculum twice as deep as its maximum breadth, which is contained more than three times in the length of the head ; very few scales serrated, but those of lateral line notched ..... *notopterus*, p. 92.
  Parietals about one-third as long as frontals, which are three times as long as broad and united by nearly straight median suture; operculum somewhat less than twice as deep as its maximum breadth, which is contained nearly three times in the length of the head ; few scales in part serrated, but those of lateral line notched. *minor*, p. 94.

II. Inner teeth on comparatively short pedicles, much enlarged.
  (*a*.) Scales smooth.
  Operculum nearly twice as deep as broad ;

Lepidolus sp. f. Platthuthal (N. Tyrol), K. Lewis, 1932, Abh. Ver. f. Naturk. B. 1932, p. 252. f.

Sensory canals, J. Pivetéau, 1935a, p. 266, f. 2.

inner teeth not excessively elarged, the majority oval and with apical tubercle; principal flank-scales with few large denticulations at least in their lower half. *leedsi*, p. 99.

Innermost splenial teeth excessively enlarged, round, without apical tubercle ..... *affinis*, p. 101.

Operculum nearly twice as deep as its maximum breadth, which equals about one-third the length of the head; inner teeth not excessively enlarged, the majority oval and with apical tubercle; scales not serrated, but the postero-inferior angle more or less produced, and the hinder margin often with one or two notches immediately above this .... *unguiculatus*, p. 102.

(*b.*) Scales in part marked with radiating furrows.

Majority of inner teeth oval, with apical tubercle, those of splenial in more than three irregular concentric series ..... *lævis*, p. 103.

Maximum width of operculum two-thirds as great as its depth, and equalling about one-third the length of the head; majority of inner teeth round, without apical tubercle, arranged on splenial in six or seven irregular concentric series..... *palliatus*, p. 103.

Majority of inner teeth round, without apical tubercle, arranged on splenial in four or five irregular concentric series ..... *maximus*, p. 105.

(*c.*) Scales smooth, but exhibiting nearly parallel transverse grooves when abraded.

Maximum width of operculum nearly two-thirds as great as its depth, and equalling about one-third the length of the head; principal flank-scales more or less coarsely serrated, sometimes crimped; dorsal ridge-scales inconspicuous ..... *mantelli*, p. 108.

Maximum width of operculum about two-thirds as great as its depth, and equalling one-half the length of the head; principal flank-scales with two or three very large denticulations on the lower half of their posterior border; dorsal ridge-scales inconspicuous ..... *degenhardti*, p. 119.

Scales with long slender posterior denticulations; principal flank-scales considerably deeper than broad; dorsal ridge-scales conspicuous ..... *hauchecornei*, p. 119.

Lepidotus elvensis (Blainville).

1818. *Cyprinus elvensis*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 394.
1830. "Fossil fish," G. Baker, Hist. Northampton, vol. i. p. 440, with plate.
1832. *Lepidotes gigas*, L. Agassiz, Neues Jahrb. p. 145.
1833–37. *Lepidotus gigas*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 8, 235, pls. xxviii., xxix. [Head, etc.; Stuttgart Museum.]
1843. *Lepidotus elvensis*, F. A. Quenstedt, Flözgeb. Württemb. p. 228.
1847. *Lepidotus elvensis*, F. A. Quenstedt, Ueber *Lepidotus* im Lias ϵ, with plates.
1886. *Lepidotus gigas*, B. Thompson, Journ. Northampton. Nat. Hist. Soc. vol. iv. p. 27, with plate.

Type. Nearly complete fish; Paris Museum of Natural History.

The type species, attaining a length of about 0·75. Head with opercular apparatus occupying about one-quarter of the total length; maximum depth of trunk contained not much more than three times in the total length. External bones nearly smooth, but in part with sparsely-arranged coarse tuberculations; parietal bones much less than half as long as the frontals, which are nearly three times as long as their maximum width, narrow in front, and united by a slightly wavy median suture; mandibular symphysis comparatively narrow. Marginal teeth acuminate, not less than three times as deep as broad. Operculum two-thirds as broad as deep, and its maximum breadth equalling somewhat less than one-half the length of the head. Fin-fulcra moderately developed; dorsal and anal fins deeper than long. Scales smooth, the principal flank-scales slightly deeper than broad, with a few coarse serrations upon the inferior half of the hinder border.

Form. & Loc. Upper Lias: Bavaria, Würtemberg, and N. France; Somersetshire and Northamptonshire, & Gloster.

P. 7406. Fish, wanting all the fins and the external surface of most of the scales and head-bones; probably from Würtemberg. The cranial roof and all the facial bones of the right side, except those bordering the mouth, are well displayed; and there are recognizable remains of the opercular apparatus and pectoral arch.

19662. Remains of head and trunk, displaying the circumorbitals, suborbitals, preoperculum, and interoperculum of the right side, with portions of the anal and caudal fins; Boll, Würtemberg. *Purchased*, 1845.

P. 7407. Imperfectly preserved fish, wanting the anterior portion of the head and all the fins, except fragments of the

1872. Lepidotus elvensis, A. Saccard? 'Rameau de Sapin', Neuchâtel, 1872, p. 20, fig. 8.

1908. Lepidotus elvensis, F. Priem, Ann de Paléontologie, vol. iii. p. 5, pl. ii. [Descript. & fig. of type specimen.]

1911. Lepidotus elvensis, O. Jaekel, Die Wirbeltiere, p. 82, figs. 89, 90 [restoration].

1921. Lep. elvensis, B. Hauff, Palaeontogr. vol. lxiv. p. 30, pl. xx. fig. 2.

1928. Lep. elvensis, T. Edinger, Anat. Anzeig. LXVI, Nr. 9/10, p. 174 fig. 4. (Sclerotic).

1929. Lep. bülowianus 9 L. queensléalti n. sp. O. Jaekel. ~~Separat~~, Abh. Geol. Pal. Inst. Univ. Greifswald N° 21 Hft 1-2. -U. Lias; Dobberten, Mecklenburg. Mitt. Mecklenb. geol. Landesanst. vol. XXXVIII (N.F. III) p. 15 Ht. 1-2. See p. 126.

1930. Lepidolus elvensis, A. S. Woodward, Proc. Somerset Archaeol. & N. H. Soc. LXXV. (1929) pp. 91-93, pl. xi.

1929. Lepidolus elvensis, O. Jaekel, Mon. Geol. Pal. III Hft. 46.

1943. L. e. C. Deckaseaux, Ann. de Paléont. 30 pp. 1-13 3 fig. pls. i-iii. (not L. sp. pl. i fig. 2).

1952. L. e. B. Hauff, Abh. Baden-Württ. p. 24, pls 44, 45.

P.7629 (2). Impression of fish in nodule;
U. Lias, Alderton, Glos. Brodie Coll.

dorsal and pelvic fins which indicate their relative position; probably from Boll.

P. 7408. Portions of small head and trunk in counterpart, displaying some of the marginal teeth, with indications of stouter teeth within; probably from Boll.

P. 2054, P. 3529 b. Hinder portion of head and the squamation of the trunk somewhat scattered, with part of the caudal fin in counterpart; Ohmden. *Egerton & Enniskillen Colls.*

P. 2014. Fragmentary remains of head and trunk, wanting fins, exhibiting a coprolite in the abdominal region; Ohmden, Würtemberg. *Egerton Coll.*

P. 3529–a. Very large specimen, displaying the squamation, remains of the paired fins, and the tubercular ornament of the cranial roof; Ohmden. Also a smaller, more imperfect fish; probably from Boll. *Enniskillen Coll.*

32421. Head and remains of trunk with some well-preserved scales; Lacaine, Normandy. Large portions of the mandible and left maxilla are exhibited, and the opercular apparatus of the left side is nearly complete. Many of the anterior flank-scales are also well preserved, exhibiting a finer serration than most of those in the German specimens. *Tesson Coll.*

32422. Well-preserved portion of squamation of the abdominal region; Lacaine. *Tesson Coll.*

18992. Head and trunk with portions of paired fins, noticed by Agassiz, Poiss. Foss. vol. ii. pt. i. p. 235, and figured in Baker's Hist. Northampton, p. 440; Upper Lias, Stowe-Nine-Churches, Northamptonshire. The perforated series of scales of the superior lateral line is conspicuous. *Miss Baker's Coll.*

18993–94. Two portions of squamation, the second with remains of the pectoral arch, opercular, and hinder facial bones; Rothersthorpe, Northamptonshire. *Miss Baker's Coll.*

Lepidotus semiserratus, Agassiz.

1822. "Pikes," Young & Bird, Geol. Yorkshire, p. 261, pl. xvi. figs. 7, 8.

1833. *Lepidotus latissimus,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 8 (undefined). [Scales: Paris Museum Nat. Hist.]

1833. *Lepidotus umbonatus,* L. Agassiz, *ibid.* p. 8 (undefined).

1837. *Lepidotus semiserratus*, L. Agassiz, *ibid.* p. 240, pls. xxix. *a*, *b*.
1849. *Lepidotus semiserratus*, W. C. Williamson, Phil. Trans. p. 441, pl. xl. figs. 3, 4.

Type. Imperfect fishes; Whitby and Scarborough Museums.

An imperfectly known species, closely related to the typical *L. elvensis*, but apparently distinguished by its more elongated form, the maximum depth being contained four times in the total length. The parietal bones also seem to be relatively longer, and the sutures between both these elements and the frontals more wavy and sharply angulated.

Form. & Loc. Upper Lias: Yorkshire [1].

All the following specimens were obtained from the cliffs near Whitby:—

P. 7409. Imperfect fish about 0·55 in length, with the base of the caudal fin and fragments of the dorsal and paired fins.

P. 2012. Larger specimen, exhibiting the ventral and partly lateral aspect, with portions of the paired and aual fins, but wanting the caudal. *Egerton Coll.*

P. 2012 a. Head and trunk, lateral aspect, with well-preserved squamation and remains of the paired fins. Some of the principal flank-scales are coarsely denticulated upon the lower half of their hinder border. The fulcra both of the pectoral and pelvic fins are prominent and, though imperfectly preserved, appear to have been double. *Egerton Coll.*

P. 3527. Imperfect fish, lateral aspect, about 0·6 in length, displaying the squamation. *Enniskillen Coll.*

P. 3528. Two specimens, ventro-lateral aspect, showing the enlarged scales in the anal region, with well-displayed remains of the caudal, anal, and paired fins. The smaller specimen also exhibits some of the marginal teeth of the upper jaw. *Enniskillen Coll.*

P. 7410. Head of a large individual with some of the anterior scales and the base of the pectoral fins. The general form of the mandible and some of its styliform teeth are well exhibited. *Purchased.*

35556. A small head, with some of the anterior scales and the base of the pectoral fins. *Purchased*, 1859.

[1] Also recorded from Boll, Würtemberg, by F. A. Quenstedt, Flözgeb. Württemb. p. 234.

1897. Lepidotus semiserratus, A.S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii. p. 325, pls. xlvi–xlviii.

1916. Lepidotus semiserratus, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1915), p. 27, text-fig. 12. [Restoration of head.]

1937. Lepidotus semiserratus, D.S. Westoll, p. 374, pl. 7a. (head).

1948. L. S. Sp. Rayner Phil. Tr. R.S. 233B. p. 303 [fr. 10-12

1936. L. S., N. Holmgren & E.G. Stensiö in Bolk et. Handb. Vergl. Anat. Wirbelt. 4: 479, figs. 364,5 (endocranium & skull)

P.7409. Des? & mx + smx. figs? Loc. cit. 1897, p. 331, pl. xlvi. fig. 3.

P. 3527. Des? & figs? Loc. cit. 1897, p. 333, pl. xlviii. fig. 2.

P. 3528. Des? & figs? Loc. cit. 1897, p. 332, pl. xlviii. fig. 1.
P. 3528a. Des? & figs? Loc. cit. 1897, p. 328, pl. xlvii. figs. 1, 1a.

P.7410. Des? Loc. cit. 1897, p. 330.

35556. Des? & figs? Loc. cit. 1897, p. 326, pl. xlvi. figs. 1, 1a.

P. 5213. Des: d porb. fij: Lor. cil. 1897, p. 330, pl. xlvi. fig. 2.
P. 5223. Pmx. d scale des: d fij: Lor. cil. 1897, pp. 332, 334, pl. xlvi. fig. 4, pl. xlvii. figs. 2-4.

P. 6394. Mandible Lestz des: Lor. cil. 1897, p. 331.

1901. Prolepidotus gallinacei, E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xlii. p. 30, pl. iii. figs. 2, 3.

P. 1127. Imperfect skull and anterior squamation, the fractured cranial roof-bones exposed from above. *Egerton Coll.*

P. 3528 a. Imperfect head, with some anterior scales and traces of the pectoral fins. The facial and cranial bones are sparsely tuberculated, and the coarseness of the serration of the scales varies considerably. The upper part of the broad hyomandibular is exposed on the right side; and there are remains of the dentition in both jaws.

Enniskillen Coll.

P. 5213, P. 5223. Two imperfect heads, with remains of the abdominal region. The sparse tuberculations upon the cranial and facial bones are well shown, and in the smaller specimen teeth are displayed.

Presented by John Edward Lee, Esq., 1885.

P. 6394. Imperfect head and lower portion of abdominal region.

Beckles Coll.

Lepidotus gallineki (Michael).

1893. *Prolepidotus gallineki*, R. Michael, Zeitschr. deutsch. geol. Ges. vol. xlv. p. 729, pls. xxxiii., xxxiv.

Type. Internal cast of imperfect head and trunk; Mineralogical Museum, University of Breslau.

A species attaining a length of about 0·3; head with opercular apparatus occupying about one-quarter of the total length to the base of the caudal fin. External bones apparently almost smooth; parietal bones antero-posteriorly elongated, at least half as long as the frontals, which meet in a nearly straight median suture; marginal teeth acuminate and inner teeth on elongated pedicles. Operculum two-thirds as broad as deep, and its maximum breadth less than one-half the length of the head. Fin-fulcra moderately developed. Scales smooth and not serrated on the hinder margin.

Form. & Loc. Rhætic: near Landsberg, Upper Silesia.

Not represented in the Collection.

Lepidotus tuberculatus, Agassiz.

1837–44. *Lepidotus unguiculatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 254, pl. xxix. *c.* fig. 1 (*non* p. 251, pl. xxx. figs. 7–9).

1837–44. *Lepidotus tuberculatus*, L. Agassiz, *ibid.* p. 256, pl. xxix. *c.* fig. 7.

(?) 1844. *Sphærodus minor*, L. Agassiz, *ibid.* pt. ii. p. 216 (name only).

1871. *Lepidotus unguiculatus*, J. Phillips, Geol. Oxford, p. 182, woodc. xli. figs. 5–7.

1871. *Pycnodus rudis*, J. Phillips, *ibid.* p. 180, woodc. xl. fig. 1. [Mandibular ramus; Oxford Museum.]

1890. *Lepidotus unguiculatus*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 292, pl. iii. figs. 7, 8.

1892. *Lepidotus unguiculatus*, A. S. Woodward, *ibid.* vol. xii. p. 239.

Type. Left suboperculum; Oxford Museum.

This specific name was originally applied to a large, coarsely-tuberculated suboperculum from the Stonesfield Slate, erroneously regarded by Agassiz as a scale. No second example has been discovered, and the only known remains of *Lepidotus* of the same age are fragmentary. It is thus impossible, as yet, to define *L. tuberculatus* scientifically; and we merely adopt the name provisionally for all the scattered remains of *Lepidotus* discovered in the English Bathonian formation. Such remains have hitherto been described as *L. unguiculatus*, Ag.; but since the type specimen of the latter species was obtained from the Kimmeridgian of Bavaria, it is extremely improbable that the Bathonian fossils pertain to the same fish, while it may be regarded as certain that at least a large proportion of these specimens will eventually prove to have been correctly referred to the position where they are now placed.

A premaxilla in the Northampton Museum exhibits four robust styliform teeth; and all the teeth on the inner elements hitherto discovered in the Bathonian are rounded and stout, though fixed on comparatively long pedicles. The teeth of the dentary bone, known in two specimens from the neighbourhood of Oxford and in one from Orton, near Peterborough, are not acuminate, but smaller than the splenial teeth and with more slender pedicles; the splenial teeth do not appear to form more than three irregular concentric series, and the crown in some is oval. The principal flank-scales exhibit two, three, or more large slender denticulations in the lower half of the hinder margin.

Form. & Loc. Bathonian: Oxfordshire, Gloucestershire, Somersetshire, Wiltshire, and Northamptonshire.

P. 1111 a. Small right squamosal, showing rugosity and course of slime-canal; Stonesfield Slate, Stonesfield, near Oxford. *Egerton Coll.*

47141. Imperfect mandibular ramus, with dentary and some splenial teeth; Great Oolite, Orton, near Peterborough. *Sharp Coll.*

P. 7411. Fragment, apparently of upper dentition; Forest Marble, Stanton, Wiltshire. *Cunnington Coll.*

1948. L.L. S.H. Rayner, Ph. Tr. R.S. 233B p. 307 ff. 13.

28606. Two detached teeth; Great Oolite, Eyeford, Gloucestershire. *Purchased*, 1853.

47137. Imperfect caudal region, measuring about 0·12 from the dorsal fin to the extremity of the upper caudal lobe and 0·065 in the depth of the caudal pedicle, noticed in Proc. Geol. Assoc. vol. xi. p. 292; Great Oolite, Collington, Northamptonshire. The scales are shown in impression and the median fins are very imperfect. The small anal is opposed to the hinder portion of the dorsal. *Sharp Coll.*

P. 471. Scale described and figured by Agassiz, *op. cit.*, under the name of *Lepidotus unguiculatus*, and recorded as *Lepidotus maximus*, Agassiz, in Egerton's 'Systematic Catalogue,' 1837; Stonesfield State. *Egerton Coll.*

28607, 37219. Three imperfect small scales; Stonesfield Slate. *Purchased*, 1853, 1863.

47980. Two caudal scales; Stonesfield Slate. *Presented by the Hon. Robert Marsham*, 1877.

P. 1111, P. 3524. Fourteen small scales; Stonesfield Slate. *Egerton & Enniskillen Colls.*

30569. Two small scales; Forest Marble, Atford, near Bath. *Purchased*, 1856.

Lepidotus latifrons, A. S. Woodward.

1893. *Lepidotus latifrons*, A. S. Woodward, Proc. Zool. Soc. p. 560, pl. xlix. figs. 1, 2, pl. l. figs. 1, 2.

Type. Bones and scales of head and trunk; British Museum.

A species attaining a length of about 1 metre; form and proportions unknown. External bones rugose and ornamented for the most part with closely-arranged tuberculations, sometimes fused into short rugæ; parietal bones very unequal in size, averaging about half the length of the frontals, which are united in a much-jagged median suture, are not much narrowed in front, and are about twice as long as broad; tooth-bearing portion of the dentary slender, somewhat deepened at the symphysis; series of supra-temporal plates comprising three scale-shaped median ones and a relatively large outer pair. Marginal teeth styliform and slender, a series of 6 in the premaxilla; inner teeth mostly larger, stouter, and obtuse, but fixed on long pedicles. Maximum width of operculum about two-thirds as great as its depth; and maximum depth of suboperculum not quite one-third that of operculum. Ring-

vertebræ absent. Fin-fulcra slender; pelvic fins arising considerably behind the middle point between the pectoral and anal fins. Scales large and smooth; principal flank-scales about as deep as broad, with conspicuous denticulations on the hinder border; caudal flank-scales with a much-produced postero-inferior angle.

Form. & Loc. Oxfordian: Huntingdonshire.

P. 6841. An imperfect disarticulated skeleton, the type specimen; Peterborough. The principal bones of the head and opercular apparatus are described and figured *loc. cit.* There are many portions of ribs and neural arches, but, except the doubtful fragment attached to the basioccipital bone, there are no traces of ring-vertebræ. *Leeds Coll.*

P. 6838. Nearly complete fish, much fractured; Peterborough. The right maxilla is preserved as described and figured, *loc. cit.* p. 562, pl. xlix. fig. 2, and the splenial bone, with its robust elongated teeth, is shown in position in the mandible; the bases of some of the large hinder vomerine teeth are also exposed. The tuberculations upon the frontals and the operculum are stronger and more closely arranged than in the type specimen. The bases of the pectoral fins are preserved, and some of the hinder rays on the right side are nearly complete; the right pelvic fin is very incomplete, but in position, and there are fragments of the anal and caudal fins. The characters of the squamation can be observed, and the three enlarged anal scales occur in position. *Leeds Coll.*

P. 6840. An associated series of scales, with some bones of the head and pectoral arch, and ribs; Peterborough. The parasphenoid, metapterygoid, and hyomandibular are described and figured *loc. cit.* pp. 561, 562, woodc. figs. 3, 6, pl. l. fig. 2. *Leeds Coll.*

Lepidotus macrocheirus, Egerton.

1845. *Lepidotus macrochirus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. i. p. 230.

Type. Imperfect fish, ventral aspect; British Museum.

A species attaining a length of about 0·7; form and proportions unknown, but trunk apparently very robust and head with opercular apparatus occupying about one-fifth of the total length of the fish. External bones more or less feebly rugose and finely tuberculated, but in great part smooth; parietal bones somewhat less than half

as long as the frontals, which are about three times as long as their maximum width, very narrow in front, and united throughout their length by a nearly straight, only feebly jagged, median suture; tooth-bearing portion of dentary slender, somewhat deepened by the sharp downward curve of its inferior border at the symphysis. Marginal teeth styliform, but slightly tumid; inner teeth mostly larger and obtuse, but on moderately high pedicles; splenial teeth in about three irregular, concentric series, largest within; hinder portion of vomerine dentition comprising three widely-spaced pairs of large teeth; hinder pterygoid teeth very small. Ring-vertebræ absent. Fin-fulcra large, but those of the median fins slender; distance between origin of pelvic and anal fins about two-thirds as great as that between the former and the pectoral fins. Scales large and smooth; principal flank-scales not much deeper than broad, with a close series of long and acuminate denticulations on the hinder border, these being represented by a gradually decreasing number of equally large and acuminate denticulations on the posterior abdominal flank-scales; caudal flank-scales with a much-produced postero-inferior angle; dorsal ridge-scales acutely pointed, in part conspicuous.

Form. & Loc. Oxfordian: Wiltshire and Huntingdonshire.

P. 7412. The type specimen described by Egerton, *loc. cit.*; Christian Malford, near Chippenham, Wiltshire. The characters of the abdominal flank-scales are not shown.

(?) *Presented by S. P. Pratt, Esq.*

P. 7413. Portions of head and trunk of a similar specimen, lateral and partly ventral aspect; Christian Malford. The left dentary, maxilla, and quadrate are displayed from the outer aspect, with other more fragmentary bones; and the characters of the squamation are well shown.

(?) *Presented by S. P. Pratt, Esq.*

P. 6839. Fragmentary head and trunk; Peterborough. The skull is vertically crushed, displaying the frontal bones and the arrangement of the teeth on the vomerine and palato-pterygoid bones. The dentigerous portion of the right mandibular ramus is detached, and shown of two-thirds the natural size from the outer and oral aspects in the diagram, fig. 19 (p. 100), where *d* indicates the dentary, and *spl.* the splenial element. Several other more or less fragmentary bones are isolated. The upper part of the operculum, so far as preserved, is smooth; and there

are slender, denticulated, calcified gill-supports. Some of the elongated basal bones of the pectoral fin are shown, and the coracoid is preserved on the left side. The characters of the squamation can be observed, and the three enlarged anal scales occur in position. *Leeds Coll.*

P. 6899. Portion of trunk in hard nodule, with associated fragments of head and fins; Peterborough. Part of the frontals, a portion of the right mandibular ramus, and the right quadrate are shown. Fragments of the pectoral, pelvic, and dorsal fins occur in position, and the dorsal fulcra are seen to be remarkably slender. The caudal fin-rays exhibit small patches of enamel; and the denticulation of the scales is especially well displayed. *Leeds Coll.*

P. 6900. Associated set of fragmentary bones and scales, comprising left parietal, right frontal, hyomandibular, ceratohyal, supraclavicle, &c., and the three anal scales; Peterborough. The portions of clavicle show several longitudinal close series of minute denticulations on the middle of its outer face. *Leeds Coll.*

Lepidotus notopterus, Agassiz.

1835–37. *Lepidotus notopterus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 257, pl. xxxv.

1850. *Lepidotus notopterus*?, V. Thiollière, Ann. Sci. phys. & nat. Lyon, [2] vol. iii. p. 138.

1852. *Lepidotus notopterus*, F. A. Quenstedt, Handb. Petrefakt. p. 197, pl. xv. fig. 4.

1863. *Lepidotus notopterus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 628.

1873. *Lepidotus notopterus*?, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 15, pl. iv.

1887. *Lepidotus notopterus*, W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. p. 382, pl. viii. fig. 5.

1887. *Lepidotus notopterus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 209, fig. 218.

Type. Well-preserved fish; British Museum.

A species attaining a length of about 0·4. Length of head with opercular apparatus nearly equal to the maximum depth of the trunk, and occupying about one-quarter of the total length. Operculum twice as deep as its maximum breadth, which is contained more than three times in the length of the head; cranial roof-bones with few sparse tuberculations; marginal teeth on much elongated

1916. Lepidotus notopterus, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal Sn. 1915), p. 34, pl. vii. fig. 6.

1949. Lepidotes not. P. de Saint-Seine, N. Arch. Mus. N. H. Lyon 2 p. 143 fig. 63 pl. XV f. A.

M. Purbeckian; Swanage, Dorset.

pedicles, but obtuse. Fin-fulcra very large, the principal dorsal fulcra more than half as long as the anterior dorsal fin-rays; pelvic fins arising much nearer to the anal than to the pectorals; dorsal and anal fins deeper than long. Scales smooth, very few serrated, but those of the lateral line and sometimes a few anterior flank-scales faintly notched on the hinder margin.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria and S.E. France.

P. 470. Type specimen described and figured by Agassiz: Solenhofen. There are some inaccuracies in the description, and the original figure is very inadequate. The cranium is exposed from the right side, the facial bones being destroyed or displaced; and the right operculum is observed above the occiput, with two branchiostegal rays, displaying the inner aspect. One of the rays partly overlaps the operculum, and thus produces the false appearance of a downwardly descending process of the latter bone in Dinkel's figure. So far as preserved, the cranial roof is remarkably smooth, but there are distinct traces of a few rounded tuberculations in the parietal region; and at the extremity of the snout there is the premaxilla of the right side, with a single series of five obtuse teeth and a stout process ascending from its internal lateral extremity to the ethmoidal region of the cranium. There are ossifications in the otic capsule, and the long, slender, apparently toothless parasphenoid meets an expanded dentigerous vomer in front. One of the hyomandibular elements occurs displaced above the head, and is shown to be comparatively slender, with a superior expansion and a large posterior process for the support of the operculum. The pterygo-palatine arcade of the left side is partly seen below the parasphenoid, and that of the right side ("maxillaire inférieur gauche" of Agassiz) is displaced further beneath and backwards, both exposed from the oral aspect; there are several series of teeth on these bones, very large in the front half, but becoming comparatively insignificant behind. Immediately in advance of the right pterygo-palatine element is the dentary bone of the right side, with a single regular series of obtuse teeth; and still further forwards are remains of other dentigerous bones, regarded by Agassiz as the maxillæ and premaxillæ. Some of the fin-rays and fulcra of the pectoral, dorsal, and caudal fins are well shown;

and, as remarked by Agassiz, all the scales are quite smooth, without either serrations or notches.

Egerton Coll.

37036. Small specimen, about 0·18 in length, with imperfect head, but displaying the squamation and dorsal and anal fins, with remains of the caudal and paired fins; Solenhofen. Each of the scales of the lateral line exhibits a single notch, but all the other scales are entirely smooth. The perforated series of scales indicating a second and superior lateral line between the occiput and dorsal fin is conspicuous. *Häberlein Coll.*

Lepidotus subovatus (Münster).

1842. *Scrobodus subovatus*, G. von Münster, Neues Jahrb. p. 37, and Beitr. Petrefakt. pt. v. p. 55, pl. i. fig. 4.
1844. *Scrobodus subovatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 203.
1863. *Scrobodus subovatus*=aberrant *Lepidotus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 639.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species of the so-called genus *Scrobodus*, closely resembling *Lepidotus notopterus* in form and proportions, but much smaller, and described as differing from all known species of *Lepidotus* in the apical indentation of the tritoral teeth.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37999. Plaster cast of type specimen; Solenhofen.

Purchased, 1864.

Lepidotus minor, Agassiz.

1833–37. *Lepidotus minor*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 9, 260, pl. xxxiv. (*non* pl. xxix. *c.* fig. 12).
1887. *Lepidotus minor*, W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. p. 363, pl. vi. fig. 2 (? *non* p. 366, pl. vi. fig. 1).
1893. *Lepidotus minor*, A. S. Woodward, Proc. Zool. Soc. p. 562, pl. xlix. fig. 3.

Type. Nearly complete fish; School of Mines, Paris.

A species attaining a length of about 0·4. Length of head with opercular apparatus somewhat exceeding two-thirds the maximum depth of the trunk, and contained nearly five times in the total length of the fish. Operculum somewhat less than twice as deep as its maximum breadth, which is contained nearly three times in the length of the head; frontal profile steep and snout acute. External bones prominently and coarsely tuberculated; parietal

P.4220. See p. 97 & Ms. opposite

1935. Lepidotus minor. W. Gross; p. 48, tf. 22-26, pl. viii f. 4, 5. (microsc.)

(?)1912. Lepidotus minor, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. [3] vol. xvii. p. 215, pl. iv. f. 7, text-figs. 7, 8.

1896. Lepidotus minor, H. Sauvin, Archiv f. Naturgesch. vol. i. p. 162 [structure of scales].

(?)1914. Lepidotus minor, G. D'Erasmo, Paleont. Italica, vol. xx, p. 82, pl. ix. f. 6; pl. x; text-figs. 16, 17.

1916 [1919] Lepidotus minor, A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1915), p. 27, pl. v. f. 6-11; pl. vi.; pl. vii. f. 1-5; text-fig. 14; also (P.S. 1917) p. 140, pl. xxvi. fig. 4, text-fig. 41.

(?)1914. Lepidotus aff. minor, E. Hennig, Archiv für Biontologie (Berlin), vol. iii. p. 296, pl. xxiii. fig. 1, text-figs. 1-4. [Wealden, Tendagurru, Tanganyika Colony; imperfect head & part of trunk.]

This restoration is corrected in A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1915), 1916, p. 28, text-fig. 14. Again op. cit. 1919, p. 140, text-f. 41.

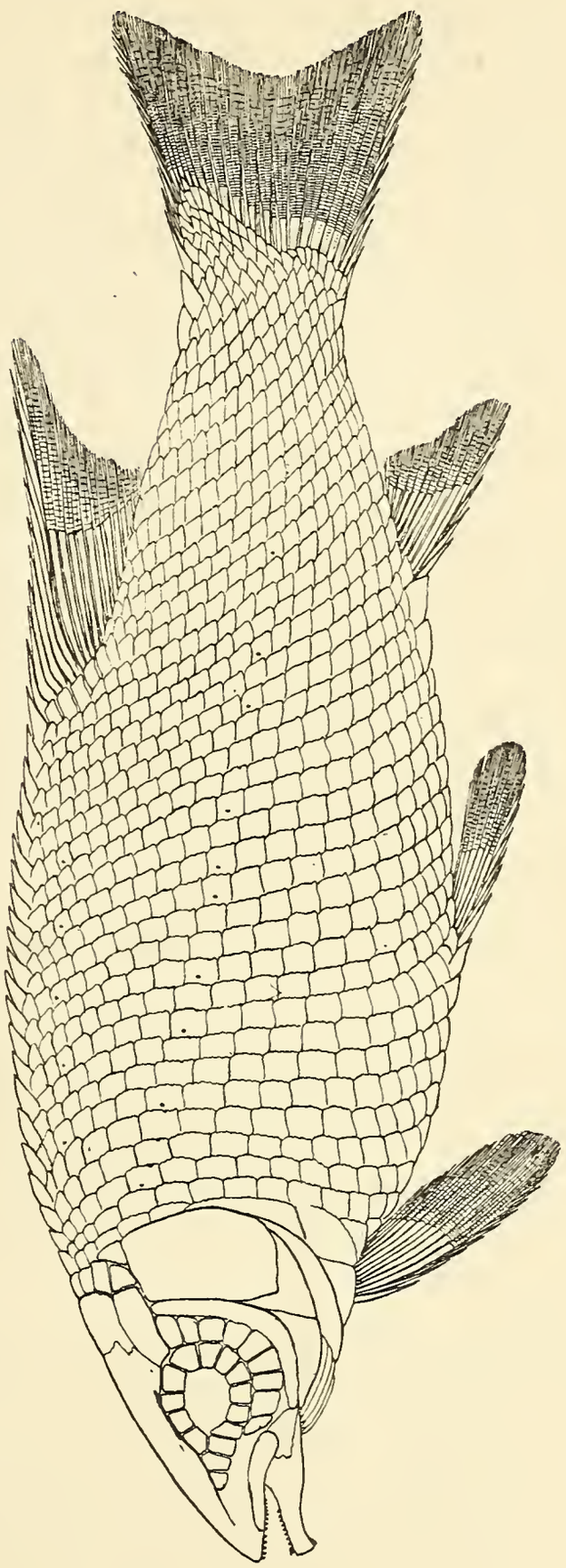

Fig. 22. *Lepidotus minor*, outline restored.

bones about one-third as long as the frontals, which are three times as long as their maximum width, narrow in front, and united by a nearly straight median suture; mandibular symphysis not much deepened or extended. Marginal teeth on much elongated pedicles, the crown obtusely conical in the lower jaw; inner teeth mostly larger and obtuse, but on moderately long pedicles. Fin-fulcra very large, the principal dorsal fulcra more than half as long as the anterior dorsal fin-rays; pelvic fins arising midway between the pectorals and the anal; dorsal and anal fins deeper than long. Scales smooth, those of the flank coarsely serrated in the young, partly without serrations, partly with few irregular denticulations in the adult; scales of lateral line notched; dorsal ridge-scales acutely pointed and prominent.

The large collection catalogued below seems to indicate that the individuals of this species grow stouter with age, besides losing the conspicuous serrations on the scales of the flank. A restoration of a typical fish is attempted in the accompanying fig. 22, of one-half the natural size, the only part remaining doubtful being the arrangement of the bones of the snout.

A small fish from the Wealden of the Deister, Hanover, assigned to this species by C. Struckmann (Wealdenbild. Hannover, 1880, p. 86), has received the provisional name of *Lepidotus struckmanni* (W. Branco, *loc. cit.* p. 368, pl. vi. fig. 1).

Form. & Loc. Purbeckian: Dorsetshire.

The following specimens were all obtained from the neighbourhood of Swanage:—

19006. Fine adult fish, with imperfect head, about 0·34 in length and 0·12 in maximum depth. The dorsal fin-fulcra are especially robust, four pairs having a separate insertion in advance of the anterior ray; and the principal flank-scales exhibit only feeble coarse denticulations in their inferior half. *Purchased*, 1845.

41157. Equally large individual, wanting the caudal and paired fins, displaying some of the ribs and median fin-supports, and the squamation of the left side from the inner aspect. Some of the left opercular and facial bones are also shown from within, and the mandibular ramus exhibits some of the splenial teeth on long pedicles posteriorly.
Purchased, 1868.

42308. Somewhat larger fish, the squamation shown only in impression and some of the cranial and facial bones from the inner aspect. *Purchased*, 1870.

(?) Cenomanian: Italy.

19006. Tail noticed A.S.W. loc. cit. 1916, p. 33; scales, p. 34.

41157. Des? dfij? A.S.W. loc. cit. 1916, pp. 33, 34, pl. vii. fig. 5.

42308. Maxilla noticed A.S.W. loc. cit. 1916, p. 30

36080. Desc? & fig? A.S.W. loc. cit. 1916, p. 29, pl. v. fig. 7.

45903. Desc? & fig? A.S.W. loc. cit. 1916, p. 32, pl. vii. fig. 3.

P. 4220. Desc? & fig? A.S.W. loc. cit. 1916, p. 35, pl. vii. fig. 6, & referred to Lepidotus notopterus.

P. 2006. Dorsal ridge-scales, desc? & fig? A.S.W. loc. cit. 1916, p. 34, pl. vii. fig. 4.

P. 5936. Imperfect large head and trunk, with portions of the dorsal and pelvic fins. The tuberculated cranial roof is exposed, and the ventral portion of the abdominal squamation is especially well displayed. The scales are not serrated, but the postero-inferior angle is acuminate.
Purchased, 1889.

P. 6370. Imperfect fish about 0·3 in length, exhibiting the tubercular ornament on the head-bones and operculum.
Beckles Coll.

36080–81. Two specimens, 0·24 and 0·29 in length respectively. The smaller fish is shown partly from the lateral, partly from the dorsal aspect, and displays some of the head-bones and the squamation: a few of the principal flank-scales are observed to be coarsely, but feebly crenulated. The trunk of the larger fish is shown chiefly as an impression, though the greater part of the dorsal fin is preserved; while in the head the left parietal and frontal, circumorbitals, and other bones are exposed from the inner aspect. *Cunnington Coll.*

45903. Imperfect small trunk, with remains of the head, displaying some of the ribs and the stout neural spines.
Purchased, 1874.

P. 4220. Large trunk, with remains of the head and part of the dorsal and caudal fins. A large portion of the squamation is well preserved, but none of the flank-scales exhibit denticulations. The dorsal fin-fulcra are unusually attenuated. *Enniskillen Coll.*

P. 4440. Imperfect small trunk displaying the fulcra of the dorsal and anal fins, and the long, curved ribs in the abdominal region. *Enniskillen Coll.*

P. 2006. Small trunk, about 0·23 in length, with portions of all the fins, especially displaying the fulcra. All the principal flank-scales of the abdominal region are coarsely though feebly serrated; and this specimen forms the basis of the restoration of the trunk in fig. 22, p. 95. *Egerton Coll.*

P. 2006 a. Head, abdominal region, and base of the tail of a similar fish, lateral aspect, with portions of the dorsal and paired fins. In the mandible the posterior teeth seem to be relatively small and arranged in more than one series; and the margin of the upper jaw is shown to be formed by

the premaxilla and maxilla, the latter element with a concavely arched oral border and shaped as in *L. latifrons*. Below and behind the mandible there occur portions of the ceratohyal and epihyal; and the cranial roof-bones, besides the operculum, are shown to be tuberculated. The serration of the principal flank-scales is very conspicuous. *Egerton Coll.*

8047. Imperfect head and abdominal region, equalling the preceding (P. 2006 *a*) in size. The tuberculations upon the cranial and facial bones are exhibited, and the clavicle is preserved behind. The removal of part of the squamation of the right side exposes the long, slender ribs and traces of the somewhat stouter neural arches, but no vertebral centra. *Mantell Coll.*

P. 6371. Imperfect small fish shortened and deepened by crushing, and exhibiting serrated scales. *Beckles Coll.*

P 5591. Imperfect head and trunk of a slightly larger individual than no. 8047, apparently deeper and with non-serrated scales. The teeth exhibited are unusually stout, diminishing in size in the hinder portion of both jaws. *Harford Coll.*

P. 4441. Imperfect head and abdominal region of a large fish, with the dorsal fin-fulcra and relatively large scales. The imperfect coronoid bone is exposed in the mandible. *Enniskillen Coll.*

P. 1118. Portion of a skull, vertically crushed and exposed from within, with some of the anterior dorsal scales shown from the inner aspect. The parietals and frontals are well shown, and the squamosal is preserved on the left side. The pair of supratemporal bones considerably overlaps the parietals; and between the two post-temporals there occurs a small median element, forming the first of the dorsal series of ridge-scales. Anteriorly the ascending process of each premaxilla is apposed to the inner face of the frontal bone of the same side; and the displaced left mandibular ramus shows that the splenial element, in addition to the dentary, bore teeth. The inner teeth are much stouter than those of the margin of the jaw; and they appear to be in three series on the anterior end of the splenial. The circumorbital and suborbital facial bones are also in part well displayed. *Egerton Coll.*

P. 5591. Entopterygoid & metapterygoid noticed A.S.W. loc. cit. 1916, p. 30; post-temporal, p. 32

P. 1118. Des. & fig. A.S.W. loc. cit. 1916, p. 29, pl. v. fig. 6.

P.7414 broken by preparation Oct. 1917.

21349. Left ectopterygoid, desc? & fig? A.S.W. loc. cit. 1916, p. 30, pl. vii. fig. 1.

P.1121a. Desc? & fig? A.S.W. loc. cit. 1916, p. 29, pl. v. fig. 9.

44848. Left hyomandibular, desc? & fig? A.S.W. loc. cit. 1916, p. 30, pl. v. fig. 10.

4825-5. Left premaxilla, desc? & fig? A.S.W. loc. cit. 1916 p. 30, pl. v. fig. 11.

21974a. ~~Right~~ dentary, desc? & fig? A.S.W. loc. cit. 1916, p. 31, pl. vii. fig. 2.

P.4989a. Scale noticed A.S.W. loc. cit. 1916, p. 34.

1905. Lepidotus aff. leedsi, H.E. Sauvage, Nouv. Catal. Poiss. Form. Second. Boulonnais, p. 10. [Teeth; Upper Portlandian, Wimille.]

P. 6 374. Imperfect head showing cranial roof from within. *Beckles Coll.*

46419. Left frontal bone. *Cunnington Coll.*

P. 1121. Larger left frontal bone. *Egerton Coll.*

P. 7414. Smallpair of frontals, with three right circumorbitals. *Enniskillen Coll.*

21974, 24816. Three parasphenoid bones. *Purchased*, 1848, 1849.

P. 1121 a. Parasphenoid. *Egerton Coll.*

48371. Right premaxilla, figured in Proc. Zool. Soc. 1893, pl. xlix. fig. 3; Middle Purbeck, Durdlestone Bay. *Beckles Coll.*

P. 1119. Left premaxilla, with a series of five teeth. *Egerton Coll.*

P. 6373. Imperfect right mandibular ramus. *Beckles Coll.*

21974 a. Two small right dentary bones. *Purchased*, 1848.

36084. Larger left dentary, with a series of nine well-preserved teeth. *Cunnington Coll.*

40655, 46411. Two left dentaries, each exhibiting ten teeth. *Purchased*, 1867, & *Cunnington Coll.*

P. 6372. Imperfect small fish probably of this species, exhibiting scales with remarkably produced postero-inferior angle. *Beckles Coll.*

Lepidotus leedsi, sp. nov.

1880. *Lepidotus minor*, R. Damon (*errore*), Geol. Weymouth, ed. 2 Suppl. pl. xi. fig. 12.

Type. Portion of skeleton; British Museum.

An imperfectly known species of small or moderate size. External cranial bones rugose and marked with sparse, fine tuberculations; opercular bones nearly smooth, with few patches of fine tuberculations. Dentary bone robust, but scarcely curved inwards, somewhat deepened by the sharp downward curve of its inferior border at the symphysis. Teeth mostly oval in form, those on the inner bones robust, but elevated on pedicles and the crown sometimes with a median apex or tubercle; teeth of dentary bone obtuse and the pedicle somewhat tumid immediately below the crown; splenial teeth in about three irregular concentric series. Operculum nearly twice as deep as its maximum breadth, and not quite twice as broad at the lower as at the upper extremity; suboperculum somewhat less than one-quarter as deep as the operculum, with very large

antero-superior process. Scales large and smooth, those of the anterior portion of the flank with few large denticulations at least in their lower half; dorsal ridge-scales with slender acumination.

Figs. 19–21.

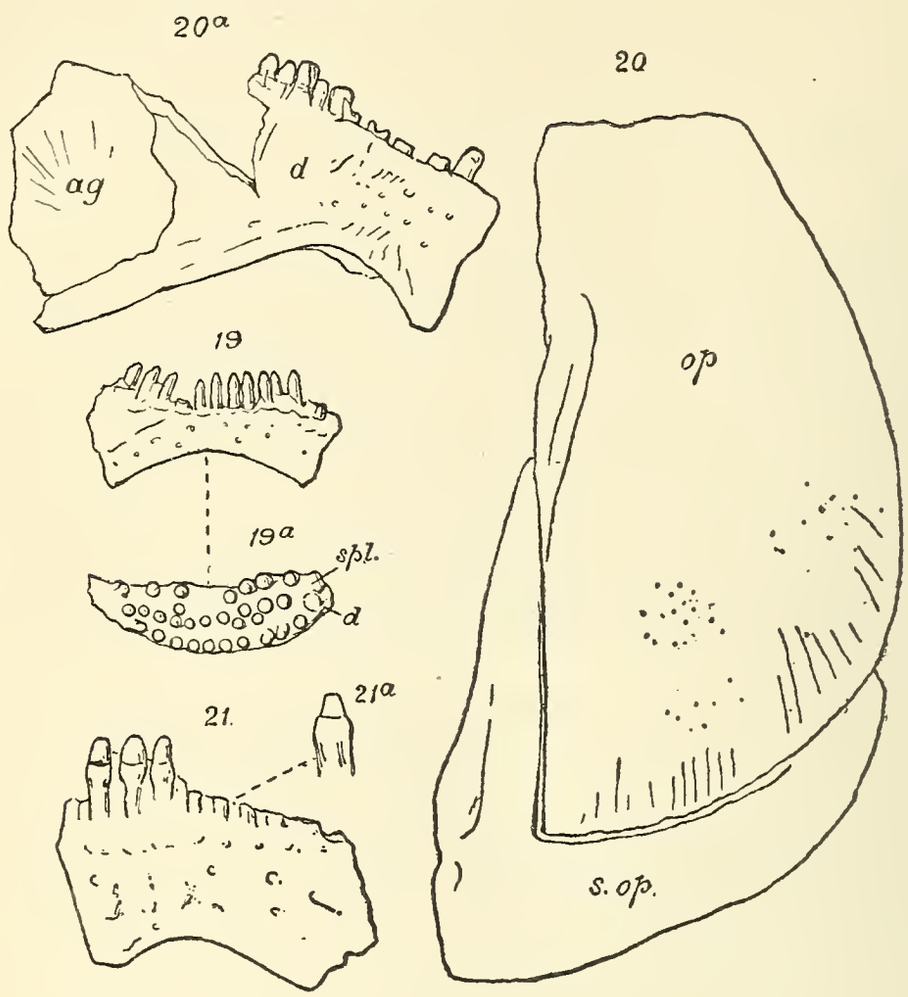

Fig. 19.—*Lepidotus macrocheirus*; anterior half of right mandibular ramus from the outer and oral (*a*) aspects.—Oxford Clay; Peterborough. [No. P. 6839.]—*d.*, dentary; *spl.*, splenial.

Fig. 20.—*Lepidotus leedsi*; left operculum (*op.*) and suboperculum (*s.op.*), outer aspect.—Oxford Clay; Peterborough. [No. P. 6837.]

Fig. 20*a*.—Ditto; imperfect right mandibular ramus, outer aspect, of same specimen, showing angular (*ag.*) and dentary (*d.*).

Fig. 21.—Ditto; left dentary, outer aspect, and lateral view of tooth (*a*).—Kimmeridge Clay; Weymouth. [No. 41964 *c.*]

All these figures two-thirds nat. size.

In this species the operculum is much larger in proportion to the mandible than in *L. macrocheirus*.

Form. & Loc. Oxfordian: Huntingdonshire. Kimmeridgian: Dorsetshire.

P. 6837. Type specimen, comprising the associated imperfect right mandibular ramus, squamosals, other cranial bones, epihyal, ceratohyals, left operculum and interoperculum,

right and left suboperculum, post-temporals, supraclavicles, left clavicle, and numerous scales; Oxford Clay, Peterborough. The operculum, suboperculum, and imperfect right mandibular ramus are shown of two-thirds the natural size in figs. 20, 20 *a*. *Leeds Coll.*

P. 6173–a. Two specimens of imperfect right dentary and splenial, showing the robust teeth on the latter element, the first specimen figured in Damon's 'Geol. Weymouth,' Suppl. pl. xi. fig. 12; Kimmeridge Clay, Weymouth. *Damon Coll.*

P. 6173 b. Imperfect left dentary showing bases of teeth; Kimmeridge Clay, Weymouth. *Damon Coll.*

41964 a–d. Fragment of upper dentition, detached teeth, imperfect left dentary with three complete teeth, and a small left dentary showing bases of teeth; Kimmeridge Clay, Weymouth. The left dentary with teeth is shown of two-thirds the natural size in fig. 21. *Purchased*, 1870.

41964 e. Left operculum, much fractured, 0·115 in depth; Kimmeridge Clay, Weymouth. *Purchased*, 1870.

41178. Portion of squamation; Kimmeridge Clay, Weymouth. *Purchased*, 1868.

P. 1112. Fragmentary portion of squamation and some detached scales; Kimmeridge Clay, Kimmeridge. *Egerton Coll.*

P. 6174. Two scales, with fractured hinder margin, one figured by Damon, *op. cit.* pl. xii. fig. 10; Kimmeridge Clay, Weymouth. *Damon Coll.*

Lepidotus affinis, Fricke.

1875. *Lepidotus affinis*, K. Fricke, Palæontogr. vol. xxii. p. 378, pl. xxi. figs. 2–6.

Type. Fragments of dentition; University Geological Museum, Göttingen.

A species of moderate size, known only by the dentition. Marginal teeth styliform and slender; inner teeth short, stout, smooth, and rounded. Splenial teeth in three irregular concentric series, the innermost excessively large; pterygo-palatine teeth relatively large, and in four irregular longitudinal series; vomerine dentition increasing in size backwards, the anterior teeth in about three

irregular longitudinal series, the largest posterior teeth comprising two pairs with one median tooth in advance.

Form. & Loc. Upper Corallian and Kimmeridgian: Hanover [1].

Not represented in the Collection.

Lepidotus unguiculatus, Agassiz.

1829. "Schuppenhaut eines unbestimmbaren Reptils," E. Rüppell, Abbild. u. Beschreib. Verstein. Solenhofen, p. 11, pl. iv.

1832. *Lepidosaurus*, H. von Meyer, Palæologica, p. 208.

1833–37. *Lepidotus unguiculatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 9, 251, pl. xxx. figs. 7–9 (*non* p. 254, pl. xxix. *c*. fig. 1).

1863. *Lepidotus unguiculatus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 623.

Type. Portion of squamation.

So far as can be ascertained from the descriptions of Agassiz and Wagner, the fine specimen mentioned below pertains to *L. unguiculatus* and justifies the following diagnosis.

A species attaining a length of about 0·8. Trunk robust, the length of the head with opercular apparatus equalling about two-thirds the maximum depth of the trunk, and occupying somewhat more than one-fifth of the total length of the fish. Maximum width of operculum slightly exceeding half its depth, and equalling about one-third the length of the head. External bones apparently smooth or sparsely ornamented. Teeth short and stout and smooth, the majority oval in outline and with a well-defined median coronal tubercle or apex. Fin-fulcra very large on the dorsal fin, comparatively small on the anal and lower lobe of the caudal fin; all the median fin-rays especially robust. Pelvic fins arising nearer to the anal than to the pectorals; anal fin arising opposite the posterior extremity of the dorsal. Scales smooth, none serrated, but the postero-inferior angle more or less produced, and the hinder margin often with one or two notches immediately above this; dorsal ridge-scales acutely pointed but inconspicuous.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37022. Nearly complete fish 0·75 in length, with the right operculum removed and shown from the inner aspect above the head, and part of the abdominal squamation disturbed; Solen-

[1] Specifically indeterminable scales from the Kimmeridgian and Portlandian of N. France (*Lepidotus fittoni*, H. E. Sauvage, *errore*, Catal. Poiss. Form. Second. Boulonnais, 1867, p. 18, pl. i. figs. 24, 25) are also ascribed to this species by H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 526. The so-called pharyngeals of *Pycnodus dutertrei* figured by Sauvage, *loc. cit.* 1867, pl. ii. fig. 9, are much like the splenials of *L. affinis*.

Lepidotus ilerpetis, Sauvage -

1903. Lepidotus ilerpetis, H. E. Sauvage, Mem. R. Acad. Ciencias Barcelona [3] vol. iv. no. 35, p. 8, pl. i. fig. 3.

Type. Imperfect fish.

L. L.
1898. L. M. Sauvage, Vert. Fos. Portugal 13 pl. iii f. 11, 12. (2 scales)
1908. Lepidotus laevis, F. Priem, Annales de Paléontologie, vol. iii. p. 2, pl. i. fig. 1.
1914. Lepidotus laevis, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 360, pl. xlviii. fig. 1.
1949. Lepidotes L. L., P. de Saint-Seine, N. Arch. Mus. N. H. Lyon 2me 137, fig. 61, 62.
1943 L. sp. C. Deckaseaux, Ann. de Pal. 30me pl. i - f. 2.

P. 2269. See p. 122.

hofen. The head is much crushed and abraded, but a few tubercles remain upon the cranial roof and the mouth is opened to display the characteristic teeth. The anal and caudal fins are especially well preserved, the latter exhibiting its gently excavated posterior margin.

Häberlein Coll.

Lepidotus lævis, Agassiz.

1837–44. *Lepidotus lævis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 254, pl. xxix. *c.* figs. 4–6.

(?) 1846. *Lepidotus subundatus*, G. von Münster (*errore*), Beitr. Petrefakt. pt. vii. p. 37, pl. iii. fig. 16. [Detached scales and teeth; Palæontological Museum, Munich.]

1860. *Lepidotus lævis*, F. J. Pictet, Descript. Rept. & Poiss. Foss. Jura Neuchâtelois, p. 26, pls. vi., vii.

(?) 1875. *Lepidotus lævis*, K. Fricke, Palæontogr. vol. xxii. p. 377, pl. xxi. fig. 1.

Type. Scale; Museum of Soleure, Switzerland.

An imperfectly known species of moderate size. Teeth short and stout and smooth, the majority oval in outline and with a well-defined median coronal tubercle or apex; splenial teeth apparently in more than three concentric series. Scales as in *L. palliatus*.

The dentition described and figured as mandibular by Fricke seems to be more probably pterygo-palatine and exhibits four longitudinal series of teeth.

Form. & Loc. Kimmeridgian: Switzerland. Upper Corallian and Lower Kimmeridgian: Hanover [1].

P. 3519. Limestone with fragmentary scales, probably of this species; Soleure. *Enniskillen Coll.*

P. 1108. Four scales, labelled by Agassiz; Soleure. *Egerton Coll.*

Lepidotus palliatus, Agassiz.

1837. *Lepidotus palliatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 255, pl. xxix. *c.* figs. 2, 3.

1833–44. *Lepidotus radiatus*, L. Agassiz, *ibid.* pt. i. pp. 9, 256, pt. ii. p. 287, pl. xxx. figs. 2, 3. [Scales; Paris Museum of Natural History.]

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[1] Specifically indeterminable scales from the Upper Kimmeridgian and Portlandian of Boulogne are referred to this species by H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (Mém. Soc. Acad. Boulogne-sur-Mer, vol. ii. 1867), p. 16, pl. i. figs. 3–16, and Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 525; also others from the Neocomian of Wassy, Haute Marne, by J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877) p. 607.

(?) 1863. *Plesiodus pustulosus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 638, pl. vii.

1867. *Lepidotus palliatus*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (Mém. Soc. Acad. Boulogne-sur-Mer, vol. ii.), p. 19, pl. i. figs. 19–23.

1867. *Lepidotus radiatus*, H. E. Sauvage, *ibid.* p. 15 (in part).

1875. *Lepidotus giganteus*, K. Fricke, Palæontogr. vol. xxii. p. 381, pl. xxi. figs. 7–9.

1877. *Lepidotus palliatus*, H. E. Sauvage, Mém. Soc. Géol. France, [3] vol. i. no. 1, p. 18, pl. i. fig. 1, pl. ii.

1880. *Lepidotus palliatus*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. pp. 458, 524, pl. xiii. fig. 1.

1880. *Lepidotus radiatus*, H. E. Sauvage, *ibid.* p. 524.

(?) 1885. *Lepidotus palliatus* F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxviii. p. 157, pl. ii. *a*. figs. 14–16.

Type. Detached scales British Museum.

A species attaining a length of about 2 metres. Trunk very robust, and head with opercular apparatus occupying somewhat less than one-quarter of the total length of the fish. Maximum width of operculum two-thirds as great as its depth, and equalling about one-third the length of the head. External bones more or less rugose or tuberculated; mandibular symphysis very robust, the dentary bone being much horizontally extended to support the large dentigerous splenial. All the teeth very short and stout and smooth, the inner and larger ones with gently rounded crown, the outer teeth more or less acuminate; splenial teeth in six or seven irregular concentric series, increasing in size within; pterygo-palatine teeth in four or five longitudinal series, increasing in size within; vomerine dentition increasing in size backwards, the anterior teeth very irregular, in about four or five longitudinal series, the largest posterior teeth comprising three successive pairs. Fin-fulcra very large; pelvic fins arising midway between the pectorals and the anal; dorsal fin remote, arising considerably behind the pelvic pair; anal fin arising opposite the hinder extremity of the dorsal. The enamel of the scales comparatively thin, sometimes discontinuous, sometimes with few granulations; principal flank-scales with a few broad ridges and furrows radiating from the centre to the hinder border, where they form indentations.

In this definition, the statement of form and proportions is based upon the first specimen mentioned below. The characters of the dentition are more clearly seen in the French specimens described by Sauvage. The left mandibular dentition is shown in Mém. Soc. Géol. France, [3] vol. i. no. 1, pl. i. fig. 1, and the vomerine dentition, *ibid.* pl. ii. fig. 11. The left pterygo-palatine dentition is shown

1908. *L. palliatus* & *L. radiatus* = *L. laevis* vars. *palliatus* & *radiatus*, F. Priem, Ann. de Paléontologie, vol. iii. p. 11. [*pall.* = Kimmeridgian; *rad.* = Bathonian.]

1913. *Plesiodiscus pustulosus*, E. Hennig, in Mann & Hennig, Mesoz. Ablag. Adamaua, Kamerun (Beitr. geol. Erforsch. Deutsch. Schutzgeb. pt. 7), p. 20, fig. 3. [Photograph of type specimen.]

1946. *L. palliatus* H. Schmidt Natur u. Volk 75/76 10/12 p. 62 Tf. 4 (Complete test 1.7 inches long.)

ibid. pl. ii. fig. 10, and another fragment of the same is described and figured in Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 458, pl. xiii. fig. 1. The maxilla and premaxilla are unknown.

Form. & Loc. Upper Corallian: Würtemberg. Kimmeridgian: N. France, S. England, Hanover, Bavaria. (?) Portlandian: Italy.

P. 338. Plaster cast of a fine specimen 1·7 in length and about 0·65 in maximum depth, with imperfect fins; Lithographic Stone, Solenhofen, Bavaria. The original fossil is a natural mould, preserved in the Palæontological Museum, Munich. *Purchased*, 1881.

32765, 33301. Detached teeth; Kimmeridge Clay, Boulogne. *Purchased*, 1859.

35762. Group of nine teeth; White Jura ε, Schnaitheim, Würtemberg. *Purchased*, 1860.

41402. A pair of squamosals, and part of another tuberculated bone, apparently associated; Kimmeridge Clay, Weymouth. Except upon the fragment, there is no tendency towards the arrangement of the tubercles in radiating series. *Purchased*, 1869.

P. 3520–1. The two type scales, described and figured by Agassiz, *loc. cit.*; Kimmeridge Clay, Boulogne. *Enniskillen Coll.*

32474, 41616. Series of twelve scales; Boulogne. *Purchased*, 1859.

P. 1107. Imperfect large scale; Boulogne. *Egerton Coll.*

42364. Two imperfect scales, with very large overlapped area; Kimmeridge Clay, Weymouth. *Purchased*, 1870.

P. 1110. Scale; Lithographic Stone, Pappenheim, Bavaria. *Egerton Coll.*

22486, 35760–61. Three scales, recorded under the name of *Lepidotus radiatus* by H. E. Sauvage, *loc. cit.* 1867, p. 16; White Jura ε, Schnaitheim, Würtemberg. *Purchased*, 1848, 1860.

Lepidotus maximus, Wagner.

1742. Figures of teeth by F. E. Brückmann, Cent. Epistol. itinerar. no. i.

1746. Figure of tooth by P. Barrère, Pierres figurées, pl. ii. no 9.

1811. Figure of tooth by J. Parkinson, Organic Remains, vol. iii. pl. xix. fig. 6.

1833. *Sphærodus gigas*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 15.

1839-44. *Sphærodus gigas*, L. Agassiz, *ibid.* pt. ii. p. 210, pl. lxxiii. figs. 83–94.
1844. *Sphærodus neocomensis*, L. Agassiz, *ibid.* p. 216. [Teeth.]
1839. *Sphærodus gigas*, F. A. Roemer, Verstein. Norddeutsch. Oolithengebirges, Nachtr. p. 54.
1850. *Sphærodus gigas*, J. Cornuel, Bull. Soc. Géol. France, [2] vol. vii. p. 703.
1851. *Sphærodus crassus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 58.
1852. *Lepidotus giganteus*, F. A. Quenstedt, Handb. Petrefakt. p. 198, pl. xiv. fig. 18. [Scale; Tübingen University Museum.]
1852. *Sphærodus gigas*, F. A. Quenstedt, *ibid.* p. 199, pl. xiii. fig. 42.
1853. *Lepidotus giganteus*, F. A. Quenstedt, Württ. Jahresh. vol. ix. p. 361, pl. vii. figs. 1–8.
1858. *Lepidotus giganteus*, F. A. Quenstedt, Der Jura, p. 780, pl. xcvi. figs. 1–4.
1858. *Sphærodus gigas*, F. A. Quenstedt, *ibid.* p. 780, pl. xcvi. figs. 5–10.
1860. *Sphærodus gigas*, F. J. Pictet, Descript. Rept. & Poiss. Foss. Jura Neuchâtelois, p. 35, pls. viii., ix., pl. xviii. fig. 1.
1860. *Sphærodus neocomiensis*, Pictet & Campiche, Foss. Terrain Crét. St. Croix, pt. i. p. 72, pl. ix. figs. 1–6.
(?) 1861. *Tetragonolepis eximius*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 87, fig. 16. [Caudal fin; Haarlem Museum.]
1863. *Lepidotus maximus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 629.
1863. *Sphærodus gigas*, A. Wagner, *ibid.* p. 630.
1864. *Sphærodus gigas*, Thurmann & Etallon, Nouv. Mém. Soc. Helv. Sci. Nat. vol. xviii. p. 431, pl. lxi. fig. 17 (*non* figs. 18, 19).
1865. *Sphærodus gigantiformis*, C. von Schauroth, Verstein. Herz. Naturaliencabinet Coburg, p. 155, pl. iv. fig. 15. [Tooth; Coburg Museum.]
1867. *Lepidotus* (*Sphærodus*) *giganteus*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais, p. 22.
1870. *Sphærodus gigas*, G. G. Gemmellaro, Studii Palæont. Fauna Calc. a *Terebratula janitor* N. Sicilia, pt. i. p. 6, pl. ii. figs. 1–14.
1870. *Lepidotus maximus*, K. A. von Zittel, Palæontogr. Suppl. p. 22, pl. i. fig. 1.
1877. *Lepidotus giganteus*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. p. 607.
1877. *Lepidotus maximus*, H. E. Sauvage, Mém. Soc. Géol. France, [3] vol. i. no. 1, p. 7, pl. i. figs. 2, 3.
1879. *Lepidotus maximus*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. p. 28.
1879. *Lepidotus neocomiensis*, H. E. Sauvage, *ibid.* p. 31, pl. ii. figs. 7–10.
1883. *Sphærodus neocomiensis*, W. Keeping, Foss. Neocom. Upware, p. 81, pl. i. fig. 4.

1897. *Sphaerodus gigas*, M. Remeš, Rozpravy České Akad. II třída. Ročník VI č. 3, p. , pl. , figs.

1896. *Lepidotus gigantheus*, H. Sauvin, Archiv f. Naturgesch. vol. i. p. 161 [structure of scale].

1908. *Lepidotus maximus*, F. Priem, Ann. de Paléontologie, vol. iii. p. 9, pl. i. figs. 4, 5.

1912. F. Drevermann,

1912. *Lepidotus maximus*, F. Priem, Bull Soc. Géol. France [4] vol. xii. p. 254, pl. viii. figs. 4, 5; text-fig. 2; also p. 261, pl. ix. fig. 4.

1922. *Lepidotus maximus*, G. D'Erasmo, Catal. Pesci Foss. d. Tre Venezie (Mem. Ist. Geol. R. Univ. Padova, vol. vi.), p. 49, pl. v. figs. 27–29, pl vi. figs. 30–34.

Teeth recorded from Portlandian of Neuquen, Argentina, by O. Haupt, Neues Jahrb. xxiii Beil.-Bd. (1907), p. 188.

1928. L. ("Sphaerodus") *maximus*, T. Edinger, Anat. Anzeig. 9/10 p. 174, fig. 6. (Reconstruction).

1930. *L. maximus*, K. Weitzel, Natur u. Museum Frankf. a. M. LX pt. 1. p. 31. figs. 7–8.

1930. *L. maximus*, K. Weitzel, Abh. Senck. Naturf. Gesell. xlii. p. 107, t-f. 19–23.

1931. *L. cf. maximus*, C.E. Weaver, Mem. Univ. Washington I, p. 469. (Tithonian: Argentina).

1930. *L. m.*, J. Thomas et C°, figs. 34. (Skincian, Algeria).

1954. *L. m.* B. Peyer Schweiz. Pal. Abh. 70, p. 1 ff. 25 – 9 pls. (Miocene, Switz.).

1885. *Lepidotus maximus*, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxviii. pp. 80, 154, pl. ii. *a*. figs. 12, 13.

1889. *Lepidotus maximus*, Etheridge & Willett, Quart. Journ. Geol. Soc. vol. xlv. p. 356, pl. xv.

Type. Detached teeth; Museums of Oxford, Paris, and Stuttgart.

The type species of the so-called genus *Sphærodus*, attaining a length of probably not less than 2 metres, but known only from fragments. Teeth very broad and gently rounded, except towards the margin of the upper jaw, where they become obtusely conical; teeth of mandible relatively large and arranged in four or five irregular concentric series. Principal flank-scales with a few broad ridges and furrows radiating from the centre to the hinder border, where they form feeble indentations; superficial layer of ganoine comparatively thin, sometimes discontinuous, sometimes with few granulations.

This species as yet is only clearly distinguished from *Lepidotus palliatus* by the characters of the mandibular dentition, and some of the fragments entered above under the last-named species may belong to *L. maximus*.

Form. & Loc. Upper Corallian: Würtemberg. Kimmeridgian: S. England, N. France, Switzerland, Tyrol, and Sicily. Portlandian: France, Italy, and Germany. Neocomian: Cambridgeshire, Berkshire, and Bedfordshire (*derived*); Haute Marne, France; Switzerland. U. Jurassic; Drôme.

P. 6723. Imperfect right splenial showing the arrangement of the dentition, with successional teeth, noticed in Quart. Journ. Geol. Soc. vol. xlv. p. 357, no. iii.; Kimmeridge Clay, Shotover, near Oxford.

Presented by Henry Willett, Esq., 1892.

P. 6724. Tooth with successor, in transverse section, figured *ibid.* pl. xv. fig. 3; Shotover.

Presented by Henry Willett, Esq., 1892.

P. 1677, P. 4658. Detached teeth; Tithonian formation, Trient, Tyrol. *Egerton & Enniskillen Colls.*

22482–83, 22488, 28506, 32754, 36148. Several detached teeth; Corallian, Schnaitheim, Würtemberg.

Purchased, 1847, 1848, 1859.

36148 a. Two abraded teeth associated with two successional teeth, each of the latter exhibiting a minute central coronal tubercle; Schnaitheim. *Purchased*, 1859.

P. 1679. Plaster cast of imperfect left palatine dentition; Upper Jurassic, Switzerland. *Egerton Coll.*

P. 4659. Detached teeth; Soleure, Switzerland. *Enniskillen Coll.*

P. 3. Two dental crowns; Favara Villabati, Sicily. *Purchased*, 1879.

30893, 32420. Several detached teeth, either of this species or *L. palliatus*; Kimmeridge Clay, Mt. Lambert, Boulogne. *Purchased*, 1857.

P. 1678, P. 4660. Six detached teeth; Kimmeridge Clay, Shotover, near Oxford. *Egerton & Enniskillen Colls.*

P. 6172. Six smaller teeth; Shotover. *Damon Coll.*

P. 4661. Several detached teeth; labelled "Kimmeridge Clay, Christian Malford, Wiltshire." *Enniskillen Coll.*

40467. Six teeth; Neocomian Bone-bed (derived from Kimmeridge Clay), Potton, Bedfordshire. *Purchased*, 1867.

49976. Four dental crowns; Potton. *Presented by R. Inwards, Esq.*, 1879.

46382 a. Three dental crowns; Neocomian (derived), Farringdon, Berkshire. *Cunnington Coll.*

28395. Two dental crowns; Farringdon. *Mantell Coll.*

40971. Seven dental crowns; Neocomian (derived), Upware, near Cambridge. *Purchased*, 1867.

ZZ. 18 (Cracherode Catalogue). Dental crown. *Cracherode Bequest.*

Lepidotus mantelli, Agassiz.

1826. Figure of marginal teeth by T. Webster, Trans. Geol. Soc. [2] vol. ii. pl. vi. figs. 5, 6.

1827. "Scales of a quadrangular form," G. A. Mantell, Foss. Tilgate Forest, p. 58, pl. v. figs. 3, 4, 15, 16.

1833. *Lepidotus subdenticulatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 9. [Scales.]

1833–37. *Lepidotus mantelli*, L. Agassiz, *ibid.* pt. i. pp. 9, 262, pl. xxx. figs. 10–15, pl. xxx. *a.* figs. 4–6, pl. xxx. *b.* fig. 2, pl. xxx. *c.* figs. 1–7.

1834–44. *Lepidotus fittoni*, L. Agassiz, *ibid.* pt. i. p. 265, pl. xxx. figs. 4–6, pl. xxx. *a.* (excl. figs. 4–6), pl. xxx. *b.* (excl. fig. 2). [Portion of fish; British Museum.]

1836–44. *Tetragonolepis mastodonteus*, L. Agassiz, *ibid.* pt. i. p. 216, pl. xxiii. *e.* figs. 3, 4 (*non* fig. 5). [Denbury; Manchester Mus.]

1841. *Lepidotus mantelli*, R. Owen, Odontogr. p. 69, pl. xxx. fig. 1, pl. xxxi.

1849. *Lepidotus mantelli*, W. C. Williamson, Phil. Trans. p. 444.

1854. *Aechmodus mastodonteus*, J. Morris, Catal. Brit. Foss. p. 317.

1896. *Lepidotus mantelli*, H. Sauvin, Archiv f. Naturgesch. vol. i. p. 162, pl. ix. fig. 8 [structure of scale].

1916. *Lepidotus mantelli*, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1915), p. 36, pl. vii. f. 7; pls. viii, ix, x; pl. xi. f. 1-14; text-f. 13, 16-18.

1908. L. m. E.B. Lankester B.M. Guide to ... Fishes p. 79 [f. 46 (restn.)].

P. 11832. Nearly complete fish showing dorsal & anal fins, des? & fig? A.S.W. loc. cit. 1916, p. 37, pl. vii. fig. 7; Wadhurst Clay, Old Roar Quarry, St. Leonards-on-Sea. C. Dawson Coll.

2456 des? & fig? A.S.W. loc. cit. 1916, p. 37, pl. viii. f. 1.

1854. *Lepidotus fittoni*, J. Morris, *ibid.* p. 331.
1854. *Lepidotus mantelli*, J. Morris, *ibid.* p. 332.
1860. *Lepidotus fittoni*, J. E. Lee, Geologist, vol. iii. p. 458, pl. xii.
1887. *Lepidotus mantelli*, W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. p. 345, pl. iii. figs. 1, 2.
1890. *Lepidotus mantelli*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 112.

Type. Portion of fish; British Museum.

A species attaining a length of about 1 metre. Trunk very robust, and head with opercular apparatus occupying about one-quarter of the total length of the fish. Maximum width of operculum nearly two-thirds as great as its depth, and equalling about one-third the length of the head; frontal profile very slightly bent and snout acute. External bones more or less rugose or tuberculated; parietal bones much less than half as long as the frontals, which are three times as long as their maximum width, very narrow in front, and united throughout their length by a nearly straight median suture; mandibular symphysis very robust, the dentary bone being much horizontally extended to support the large dentigerous splenial. Inner teeth very short and stout, the majority, when unworn, with a slightly acuminate crown, but always smooth; marginal teeth also robust; splenial teeth in five (sometimes six) irregular concentric series increasing in size within; pterygo-palatine teeth in three (sometimes four) longitudinal series increasing in size within; vomerine dentition increasing in size backwards, the anterior teeth very irregular, in about four longitudinal series, the largest posterior teeth comprising two pairs with one median tooth in advance. Ring-vertebræ present in the adult. Fin-fulcra very large; pelvic fins arising nearer to the pectorals than to the anal; anal fin arising opposite the hinder extremity of the dorsal. Scales smooth, those on the flanks often crimped towards their hinder border and more or less coarsely serrated, those of the lateral line deeply notched, and all showing oblique ridges when worn; principal flank-scales somewhat deeper than broad; dorsal ridge-scales inconspicuous but acuminate.

Form. & Loc. Wealden: S.E. England and N. Germany.

2456. Hinder portion of head with part of the abdominal region, described and figured by Agassiz, *tom. cit.* p. 263, pl. xxx. *c.* fig. 1, and to be regarded as the type specimen; Heathfield. The drawing is very unsatisfactory, and there is no indication of the few coarse denticulations exhibited by some of the scales. The left hyomandibular and meta-

pterygoid are partly exposed, and the preoperculum appears to owe its peculiar form to crushing and fracture. The operculum and suboperculum are also much broken, but their true proportions seem to be as described by Agassiz. The uppermost postclavicular scale is conspicuous, and there are traces of the elongated basal bones, besides the coracoid, at the origin of the pectoral fin. The fulcra on the latter are distinctly biserial, and the fin-rays are undivided except quite at the extremity. The obliquely-ridged structure of the scales can be faintly seen through the enamel, which is well preserved.

Mantell Coll.

P. 6337. A fine specimen, originally about 0·9 in length, wanting the extremity of the snout and the pectoral fins, but displaying part of the base of each of the other fins; Hastings. The opercular and head-bones are coarsely tuberculated as in the type specimen, and the operculum is nearly similar in proportions; but the preoperculum is shaped as in the so-called *L. fittoni*, and the suboperculum seems to have been nearly half as deep as the operculum. The pelvic fins arise considerably nearer to the position of the pectoral arch than to the anal, and both these fins display large fulcra; of the dorsal and caudal fins only insignificant fragments remain. The dorsal part of the abdominal region is crushed and displaced, but the greater part of the squamation is undisturbed, and the principal flank-scales exhibit a feeble pectination. *Beckles Coll.*

P. 6336. Another fine specimen, equally large, wanting the paired fins but displaying the greater part of the anal and caudal; Hastings. The operculum is as described in *L. fittoni*, but whether or not its comparative smoothness is due to abrasion, is uncertain; the cranial and facial bones are irregularly rugose, not exhibiting sharp tuberculations. The dorsal fin is shown to have arisen at about the middle point of the back, but only the large anterior fulcra and two fragments of rays are preserved; the anal fin, with numerous more slender fulcra, seems to have been deeper than long; and the robust caudal fin-rays are shown to have been very closely articulated quite to their base. All the scales are smooth, but those on the anterior portion of the flank exhibit serrations, and each scale of the lateral line is conspicuously notched. The perforations of the

P. 6336. Dorsal fin-fulera noticed by A. S. W. loc. cit. 1916, p. 46.

P.6338. Divided circumorbital noticed by A.S.W. loc. cit. 1916, p. 40.

P.6339 presd by Juniper Hall Field Centre August 1950 E.W.

P.5129. Some scales desc? & fig? A.S.W. 1916, p. 46, pl. viii. fig. 4.

scales for the dorso-lateral line are also seen as far as the origin of the dorsal fin; and the small ridge-scales, only preserved for a short distance behind the head, exhibit a comparatively blunt acumination. At the base of the dorsal and caudal fins one fringing row of scales is directly related to the fin-rays and fulcra, and does not conform to the regular flank-series of the trunk; at the base of the anal fin the squamation is lost. *Beckles Coll.*

P. 4915. A more imperfect and fractured specimen, in counterpart; Hastings Sands, Silver Hill, Hastings. The antorbital portion of the skull is wanting, but most of the circumorbital and suborbital bones are preserved and the former are larger than the latter. The preoperculum is coarsely rugose, while the operculum and suboperculum are closely and finely tuberculated; owing to fracture, the form of the operculum cannot be satisfactorily determined, but the proportions of the suboperculum seem to be as in the so-called *L. fittoni*, and its anterior ascending process is much more robust than in the type specimen of *L. mantelli*. Part of a pectoral fin is preserved, and the rays are shown to have been very closely articulated distally. Fragments of the dorsal and caudal fins and the imperfect squamation present no features worthy of special note.

Dawson Coll.

P. 6338. Head and greater portion of trunk, apparently much abraded, and showing only the origin of the dorsal fin; Hastings. The head-bones show traces of fine tuberculations besides the coarse rugæ, but the much-fractured operculum is smooth. The fluted structure of the scales is exposed by abrasion; the principal flank-scales are serrated; and the dorsal ridge-scales do not exhibit traces of an acumination until beyond a considerable distance from the head. *Beckles Coll.*

P. 6339–40. Two more imperfect, similarly abraded specimens; Hastings. *Beckles Coll.*

P. 5129. Imperfect abraded head and portion of trunk, displaying the symphysis of the mandible and the lower extremity of the right clavicle; Horsham. The external head-bones are coarsely rugose and in part tuberculated; the operculum and suboperculum are rugose only, but seem to have been much abraded. The ascending process of the

suboperculum is both broad and remarkably long. The teeth are partly acuminate, partly round; but it is probable that most of the latter owe their form to wear. The principal flank-scales are serrated, and the fluted structure is shown in all the scales from which the enamelled surface has been removed. *Purchased*, 1886.

20673 a. A much crushed and abraded head, with the anterior portion of the abdominal region, the type specimen of the so-called *L. fittoni*, figured by Agassiz, *tom. cit.* pl. xxx. *a.* fig. 1; Highfure, Billingshurst. The mandibular rami differ from those of the preceding specimen in having their inferior margin considerably curved downwards to a point at the symphysis. The openings in the scales of the dorsal region for sensory canals are not very regularly arranged. *Presented by P. J. Martin, Esq.*, 1846.

43073. A much more imperfect, crushed specimen; East Grinstead. *Purchased*, 1871.

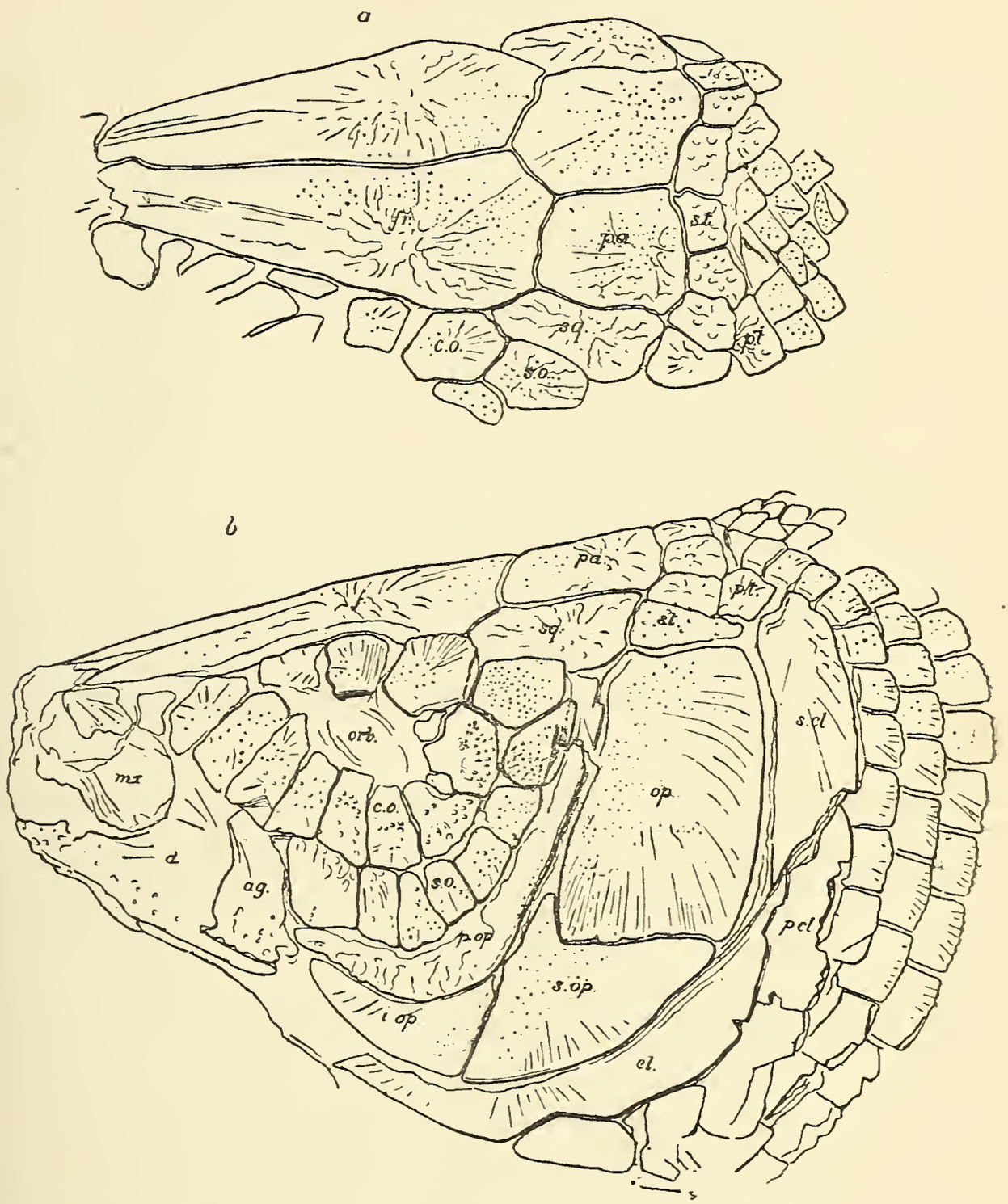
P. 6933. Fine example of the head and anterior abdominal region of a young individual, shown of one-half the natural size from the superior (*a*) and left lateral (*b*) aspects in the accompanying fig. 23; Hastings. The extremity of the snout is broken away, and only a doubtful fragment of bone appears to represent the maxilla (*mx.*) on the left side. The cranial roof-bones are in part coarsely rugose and ornamented with very fine tuberculations, mostly in radiating lines; the supratemporal plates (*s.t.*) are arranged in four pairs, the two innermost not quite symmetrical and representing the single pair in adults. The mandible is shown, partly smooth, partly with the characteristic coarse rugosity; and the inferior border of the dentary bone (*d.*) is very sharply curved downwards to a point at the mandibular symphysis. The circumorbital (*c.o.*), suborbital (*s.o.*), and opercular bones are well preserved on the left side; the first two series marked with a few large tubercles in their lower portion, more delicately ornamented above, and the opercular bones very finely granulated. The maximum width of the operculum (*op.*) is two-thirds as great as its depth, and its anterior margin is sinuous, exhibiting a considerable concavity above; the maximum depth of the suboperculum (*s.op.*) is about half that of the operculum, and its anterior ascending

20673a des? & fig? A.S.W. 1916, p. 37, pl. viii. fig. 2.

P.6933 des? & fig? A.S.W. loc. cit. 1916, p. 39, pl. ix.

process seems to be short and stout. The left clavicle (*cl.*) and supraclavicle (*s.cl.*) are also exhibited, and there are traces of large postclavicular scales (*p.cl.*) above and in front of the base of the pectoral fin. The scales of the flank are all strongly, but finely, serrated, and those of

Fig. 23.



Lepidotus mantelli; head from superior (*a*) and left lateral (*b*) aspects, one-half nat. size.—Wealden; Hastings. [N.P. 6933.]

ag., angular; *c.o.*, circumorbitals; *cl.*, clavicle; *d.*, dentary; *fr.*, frontal; *i.op.*, interoperculum; *op.*, operculum; *orb.*, orbit; *p.cl.*, postclavicular scale; *p.op.*, preoperculum; *p.t.*, post-temporal; *pa.*, parietal; *s.cl.*, supraclavicle; *s.o.*, suborbitals; *s.t.*, supratemporals; *sq.*, squamosal.

the lateral line are also deeply notched; the dorsal ridge-scales are acuminate from the beginning, and many of the anterior dorso-lateral scales are very finely tuberculated. *Rufford Coll.*

P. 6341. Large head, somewhat fractured and abraded and wanting the rostral extremity; Hastings. The external bones are all very coarsely rugose, without tuberculations; and the unworn teeth of the roof of the mouth are distinctly acuminate. The operculum has a sinuous anterior margin, and its depth is slightly more than twice that of the sub-operculum. At least six slender branchiostegal rays are fixed to the epihyal; the ceratohyal is long and much constricted mesially; the hypohyal, shown on each side, and noticed in Proc. Zool. Soc. 1893, p. 563, is short and stout, with a deep transverse groove. Behind and below the head, the pointed and expanded inferior ends of the clavicles are well exhibited, and a few of the anterior scales remain. *Beckles Coll.*

P. 6342. A smaller imperfect, abraded and fractured head, displaying in transverse section the structure of the jaws; Hastings. The section of the rostrum and upper dentigerous bones is described and figured in Proc. Zool. Soc. 1893, pp. 560, 562, pl. xlix. fig. 4, and the small coronoid bone of the mandible, shown on each side, is noticed, *ibid.* p. 563. *Beckles Coll.*

P. 6343. A less imperfect, abraded head; Hastings. *Beckles Coll.*

P. 6344–46. Six much abraded and fragmentary heads, one sliced to show the comparatively slight ossification of the inner elements of the cranium; Hastings. *Beckles Coll.*

P. 1124. Waterworn specimen of the cranium with some of the anterior scales and ring-vertebræ; Hastings. The ex-occipital and pro-otic bones are seen in contact, and the coarsely cancellated structure of all the inner bones is displayed. The supratemporal plates, of which the median pair are preserved, overlap the hinder border of the cranium. *Egerton Coll.*

P. 7415. Hinder portion of head, with some anterior scales, showing the small, triangular post-temporal bone and part of the parasphenoid; ~~Sussex~~. Ockley, Surrey.

Transferred from the Old Indian Museum, 1880.

P.6342. Transverse section des? & fig? A.S.W. loc. cit. 1916, p. 39, text-fig. 16. Sphenodia noticed, p. 38. Coronoid noticed, p. 42. Vomer & palatine, p. 42, pl. xi. fig. 1.

P.6343. Calcified gill-supports noticed by A.S.W. loc. cit. 1916, p. 43.

P.1124 des? & fig? A.S.W. loc. cit. 1916, p. 37, pl. x. fig. 1.

P.7415. Original drawings from "Greenough Coll." in Geological Library bearing inscription "Sussex marble quarry, Ockley, Surrey.

2401 des? & fig? A.S.W. loc. cit. 1916, p. 44. pl. viii. fig. 3.

2528 noticed by A.S.W. loc. cit. 1916, p. 40.

2326. Right splenial & dentary des? & fig? A.S.W. loc. cit. p. 42, pl. xi. fig. 5.

2401. Hinder portion of head, with some anterior scales and ring-vertebræ; Sussex. The supratemporal plates are not in symmetrical pairs, but three on one side of the median line and two on the other. The operculum is coarsely tuberculated and the ascending process of the suboperculum is long and slender; but the anterior margin of the former is strongly sinuous. *Mantell Coll.*

P. 6566. Parasphenoid bone, imperfect at each extremity, but showing the ascending lateral processes with superior bifurcation; Hastings. *Beckles Coll.*

2399. Left frontal ascribed by Agassiz (*tom. cit.* p. 264, pl. xxx. *b.* fig. 2) to *L. mantelli*; Tilgate Forest. *Mantell Coll.*

2528. Right frontal ascribed by Agassiz (*tom. cit.* p. 264, pl. xxx. *b.* fig. 3) to the so-called *L. fittoni*; Tilgate Forest. *Mantell Coll.*

P. 7416–17. Left frontal and portion of right frontal; Hastings. *Dawson Coll.*

2217. Imperfect left operculum; Tilgate Forest. *Mantell Coll.*

2219. Imperfect right suboperculum; Tilgate Forest. *Mantell Coll.*

2209. Right preoperculum, inner aspect; Tilgate Forest. *Mantell Coll.*

P. 7418. Right preoperculum; Tilgate Forest. *Enniskillen Coll.*

2711. Ceratohyal; Tilgate Forest. *Mantell Coll.*

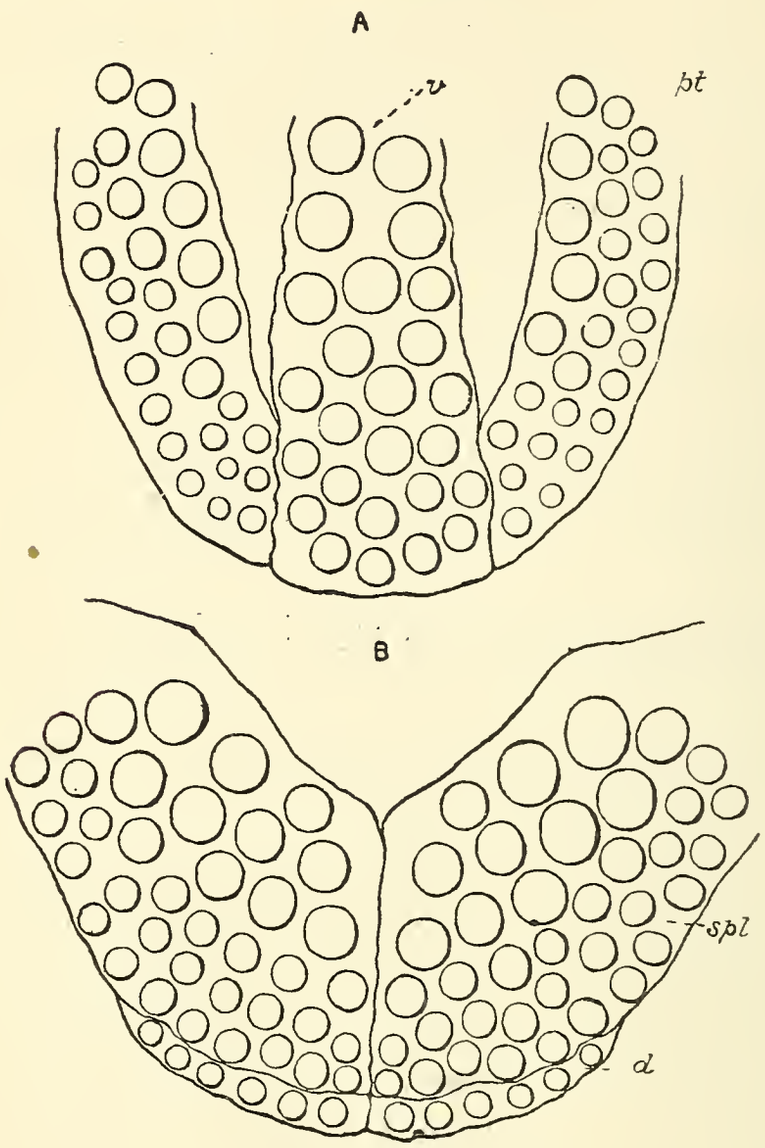
2326. Three portions of dentition figured by Agassiz, *tom. cit.* pl. xxx. *a.* figs. 4, 5, pl. xxx. *c.* figs. 2, 3; Tilgate Forest. The first figure represents the greater part of the right mandibular dentition with the comparatively small series of teeth on the dentary bone; the second specimen is the middle portion of a vomer; and the third specimen, shown in the two last-named figures, is the pterygo-palatine dentition apparently of the left side. *Mantell Coll.*

28412. Associated vomer, left pterygo-palatine, and right mandibular ramus of a large individual; Sussex. The vomer shows the characteristically-arranged five posterior teeth, with the smaller anterior teeth in four very irregular longitudinal series; the pterygo-palatine has a minute fourth outer series of teeth; the bases of six small teeth of the

single series in the dentary bone are exhibited in the mandibular ramus, and some of the outer splenial teeth are broken away. *Mantell Coll.*

P. 3516. Fragmentary trunk with imperfect upper and lower dentition, much worn, and also the opercular apparatus; Tilgate Forest. The pterygo-palatine teeth are in three series, and a few of the comparatively small dentary teeth are preserved. *Enniskillen Coll.*

Fig. 24.



Lepidotus mantelli; diagram of arrangement of teeth in upper (A) and lower (B) jaws, chiefly based upon specimens Nos. P. 3516 and P. 6363.
d., dentary; *pt.*, pterygo-palatine; *spl.*, splenial; *v.*, vomer.

P. 3518. Rostral region of skull displaying vomerine and pterygo-palatine dentition; Hastings. *Enniskillen Coll.*

P. 6363. Five portions of dentition, comprising a vomer with remarkably acuminate teeth, two left mandibular rami,

P.6363. Vonwiller del? & fig! A.S.W. loc. cit. 1916, p. 42, pl. xi. fig. 2.

P.4917. Pterygo-palatine des? & fig? A.S.W. loc. cit. 1916, p.41, pl. xi. fig. 3.

P.4995. Teeth des? & fig? A.S.W. loc. cit. 1916, p. 42, pl. xi. fig. 6.

23624. Hyoid arch des? & fig? A.S.W. loc. cit. 1916, p. 43, pl. x. fig. 2. Clavicle noticed, p. 45; also basals of pectoral fin.

P.6348 c. Des? & fig? A.S.W. loc. cit. 1916, p. 44, text-f. 18.

one right mandibular ramus, and a fragment; Hastings. The arrangement of the teeth of the vomer and one splenial is shown in fig. 24. *Beckles Coll.*

P. 1126. Fragments of dentition; Sussex (?). *Egerton Coll.*

2327, 2841, 2844, 28412 a. Fragments of dentition; Sussex. *Mantell Coll.*

P. 4917. Right pterygo-palatine and two fragments; Hastings. *Dawson Coll.*

P. 4995. Right dentary showing three marginal teeth; Hastings. *Presented by J. E. Lee, Esq.*, 1885.

2524. Right clavicle, inner aspect; Tilgate Forest. *Mantell Coll.*

P. 6362. Fragmentary trunk, with hinder extremity of head; Hastings. *Beckles Coll.*

23624. Crushed remains of head and anterior portion of trunk; Perch Hill, Brightling, Sussex. The imperfect metapterygoid and quadrate are shown in position on the left side, and the greater part of the hyomandibular is preserved on the right. The left epihyal, ceratohyal, and hypohyal are displaced and well shown in series; and the uppermost, broad branchiostegal ray occurs immediately behind. The clavicles and some of the postclavicular scales are exposed; and at the base of the pectoral fin on the right side there are five elongated basal bones. *Presented by Rev. Joseph Gould*, 1849.

P. 6347. Anterior portion of trunk; Hastings. *Beckles Coll.*

2676. Hinder portion of trunk, apparently noticed by Agassiz, *tom. cit.* p. 263; Tilgate Forest. *Mantell Coll.*

P. 6348 c. Fragment of trunk showing well-ossified ring-vertebræ, with neural and hæmal arches of the abdominal region; Hastings. The neural spine is not fused with the pedicles of the arch, and each ring as preserved seems to consist of four pieces. *Beckles Coll.*

P. 469. Portion of squamation figured by Agassiz, *tom. cit.* pl. xxx. *c.* fig. 4; Tilgate Forest. *Egerton Coll.*

36592. Portion of squamation; Sussex. *Dixon Coll.*

40319. Portion of squamation, finely serrated; Tunbridge Wells. *Purchased*, 1867.

47984. Portion of squamation and some portions of the axial skeleton; locality unknown.
Presented by the Hon. Robert Marsham, 1877.

P. 1122. Portion of squamation, finely serrated; Tunbridge Wells.
Egerton Coll.

P. 3517 a–c. Three portions of squamation, the third being a large part of the caudal pedicle; Hastings and Tilgate Forest.
Enniskillen Coll.

P. 5129 a. Portion of squamation; Horsham, Sussex.
Purchased, 1886.

The Collection also comprises numerous detached scales and teeth from the Mantell and other Collections.

Most of the following Wealden specimens may also probably belong to *L. mantelli*, but they cannot as yet be specifically determined:—

P. 6349. Abraded remains of small head and abdominal region, showing the neural arches and well-developed ribs; Hastings. The flank-scales are not serrated.
Beckles Coll.

37240. Natural mould of hinder half of head and greater portion of trunk of a small fish; Rusthall Common, Tunbridge Wells. *Purchased*, 1863.

P. 6739, P. 6739 a. Very small left premaxilla with five teeth and the base of a sixth, and wanting the ascending process; also a still smaller right dentary with similarly slender teeth; Hastings. *Rufford Coll.*

47504. Vomerine and right pterygo-palatine dentition; Isle of Wight. The teeth are arranged as in *L. mantelli*, but some exhibit coronal rugæ radiating from the apex to a slight cingulum at the base. *Purchased*, 1876.

40539. Two portions of mandible with smooth teeth; Hastings Sands, Isle of Wight. *Purchased*, 1867.

P. 1126 a–c. Three portions of mandible, with relatively small and numerous outer splenial teeth, all smooth; Isle of Wight.
Egerton Coll.

P. 7097. Fragment of dentition; Brook, Isle of Wight.
Purchased, 1894.

P.4916. Middle flank-scale, des? & fig? A.S.W. loc. cit. 1916, p. 47, pl. xi. fig. 7; Hastings. Dawson Coll.

2397. Middle flank-scale, des? & fig? A.S.W. loc. cit. 1916, p. 47, pl. xi. fig. 8; Tilgate Forest. Mantell Coll.

3036, 3092. Two upper flank-scales, des? & fig? A.S.W. loc. cit. 1916, p. 47, pl. xi. figs. 9, 10; Tilgate. Mantell Coll.

3089, 3045. Two lower flank-scales, des? & fig? A.S.W. loc. cit. 1916, p. 47, pl. xi. figs. 11, 12; Tilgate. Mantell Coll.

26009 — . Two caudal scales, des? & fig? A.S.W. loc. cit. 1916, p. 47, pl. xi. figs. 13, 14; Tilgate. Mantell Coll.

47504. Des? & fig? A.S.W. loc. cit. 1916, p. 43, pl. xi. fig. 4.

P. 6363 a, b. Two portions of dentition, many of the teeth being relatively small and well spaced; Hastings.
Beckles Coll.

P. 1123, P. 1125. Two waterworn portions of squamation; Isle of Wight. *Egerton Coll.*

P. 7419. Scales; Brook, Isle of Wight.

Lepidotus degenhardti, Branco.

1885. *Lepidotus degenhardti,* W. Branco, Jahrb. preuss. geol. Landesanst. 1884, p. 183, pl. viii., pl. ix. fig. 1.
1887. *Lepidotus degenhardti,* W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. p. 330, pl. i.
1887. *Lepidotus degenhardti,* var. *dubia,* W. Branco, *ibid.* p. 332, pl. ii. figs. 1–5.

Type. Imperfect fish; Geological Survey Museum, Berlin.

A large species closely resembling *L. mantelli*, but apparently somewhat deeper in proportion to its length. Maximum width of operculum about two-thirds as great as its depth, and equalling one-half the length of the head; frontal profile very steep, slightly convex. External bones more or less rugose or tuberculated. Inner teeth short and stout, with a smooth and slightly acuminate crown. Fin-fulcra very large; pelvic fins arising midway between the pectorals and the anal; anal fin arising opposite a point considerably in advance of the hinder extremity of the dorsal. Scales showing a few oblique ridges beneath the enamel in their anterior half; principal flank-scales with two or three very large denticulations on the lower half of their posterior border; dorsal ridge-scales inconspicuous but acuminate.

Form. & Loc. Wealden: Obernkirchen, Prussia.

Not represented in the Collection.

Lepidotus hauchecornei, Branco.

1887. *Lepidotus hauchecornei,* W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. p. 348, pl. iv. figs. 1, 2, pl. vii. fig. 1.

Type. Imperfect fish, wanting the greater part of the caudal region; Geological Survey Museum, Berlin.

A species of moderate size, attaining a length of about 0·5. Trunk deeply fusiform, and head with opercular apparatus occupying nearly one-quarter of the total length of the fish. External bones ornamented with very large, closely arranged tuberculations. Fin-fulcra very large, but slender; pelvic fins arising midway between

the pectorals and the anal; anal fin arising opposite the hinder portion of the dorsal. Scales smooth, those of the flank with long, slender posterior denticulations, which are numerous and closely arranged on the anterior part of the abdominal region, fewer behind; principal flank-scales considerably deeper than broad; dorsal ridge-scales acuminate and conspicuous.

Branco recognizes a variety of this species in which the most anterior scales exhibit only sparse denticulations, named *L. hauchecornei* var. *paucidentata* (*loc. cit.* p. 356, pl. v. fig. 1). To the same variety he also doubtfully assigns some fragments determined as *L. fittoni* by W. Dunker, Monogr. Norddeutsch. Wealdenbild. (1846), p. 63, pl. xiv., pl. xv. fig. 8.

Form. & Loc. Wealden: Obernkirchen, Prussia.

Not represented in the Collection.

The following specifically indeterminable specimen exhibits scales much resembling those of *L. hauchecornei*:—

28622. Opercular and pectoral region of a very large fish, with part of the abdominal squamation; Purbeck Beds, Swanage. The operculum measures 0·1 in maximum depth and 0·055 in maximum width, and is rugose though very sparsely tuberculated. It is more than four times as deep as the suboperculum, which is similarly rugose and exhibits the usual antero-superior ascending process. The serrations on the flank-scales are probably enlarged by imperfect preservation, but they must nevertheless have been originally very conspicuous. *Purchased*, 1853.

Lepidotus mawsoni, A. S. Woodward.

1860. *Lepidotus*, Sir P. Egerton, in S. Allport, Quart. Journ. Geol. Soc. vol. xvi. p. 265, pl. xiv. figs. 5–13, pl. xv. figs. 1–4, pl. xvi. figs. 10–12.

1888. *Lepidotus mawsoni*, A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. ii. p. 135.

Type. Detached scales; British Museum.

A large species known only from detached scales, teeth, and fragments. Scales much thickened and deeply overlapping; principal flank-scales with frequently discontinuous enamel, marked with a few broad ridges and furrows radiating from the centre to the hinder border, where they form feeble indentations; none of the scales serrated. Teeth, apparently of the same fish, rounded and comparatively small.

Form. & Loc. Cretaceous: Bahia, Brazil.

See Santos overleaf 1.

Lepidotus souzai, A.S. Woodw.

1908. Lepidotus souzai, A.S. Woodward, Quart. Jour. Geol. Soc. vol. lxiv. p. 359. pl. xliii. figs. 1, 2.
Type. Imperfect fish; British Museum.
Form. & Loc. Lower Cretaceous: Ilhéos, Bahia, Brazil.
P.10601. Ilhéos (nr Santos Island).

1935b. L. aff. souzai Weiler p. 24, pl. iii. f. 14, 27, 29-30.
Cenomanian. - Bahia.
? = Polypteridae acc. Stromer 1936, p. 41.

1953 L. s. R. da S. Santos Bol. div. Geol. Min. R. de J., no 145 p. 9 pl. 1. f. 1.

L. roxoi sp. nov. U. Cret. Brazil, R. da S. Santos 1953 Bol. div. Geol. Min. R. de Janeiro no 145 p. 10 figs 1-3 pl. i, f. 2, 3, ii-v, vi f. 1. [Imp. fish.].

1909. Lepidotus(?) pustulatus, A.S. Woodward, Proc. Fishes English Chalk (Pal. Soc.), p. 161, pl. xxxv. f. 1-4.
1935b. L. cf. L. Weiler, p. 23, pl. ii. f. 1-2, 13, 15, 25. 26.
Cenomanian. - Bahia.
1936. L. cf. L. Stromer, p. 78. fig. 15A.

P. 5534 a, b. Two type scales described, *loc. cit.* 1888; Bahia.
Presented by Joseph Mawson, Esq., 1888.

P. 410, P. 412, P. 2280. Series of detached scales and teeth; Plataforma, Bahia.
Presented by Joseph Mawson, Esq., 1881, 1882.

P. 7112. Twelve scales and two head-bones; from beach between Plataforma and Itacaranha.
Presented by Joseph Mawson, Esq., 1893.

P. 7113. Scales; Itacaranha.
Presented by Joseph Mawson, Esq., 1893.

P. 7114. Scales; Pedra Furada Bay, Montserrat.
Presented by Joseph Mawson, Esq., 1893.

P. 7118. Scales; various localities near Bahia.
Presented by Joseph Mawson, Esq., 1893.

P. 7341. Thirteen scales figured in Quart. Journ. Geol. Soc. vol. xvi. pl. xiv. figs. 6–12, pl. xv. figs. 1–4, pl. xvi. figs. 10–12.
Presented by Samuel Allport, Esq., 1894.

P. 7343. Scales; Bahia. *Presented by Samuel Allport, Esq.*, 1894.

P. 7340. Head-bone figured as a crocodilian scute, *loc. cit.* 1860, pl. xvi. fig. 9; Bahia.
Presented by Samuel Allport, Esq., 1894.

P. 7342. Five head-bones; Bahia.
Presented by Samuel Allport, Esq., 1894.

P. 7344. Hyomandibular, remarkable for the thin laminar expansion of its hinder margin below the upper articulation; Bahia. *Presented by Samuel Allport, Esq.*, 1894.

Lepidotus (?) pustulatus, sp. nov.

[Plate VIII. fig. 1.]

Type. Associated scales; British Museum.

A large species known only by scales, some of which measure 0·035 in length in their exposed portion. Scales moderately robust, with a thin and sometimes discontinuous layer of enamel, marked with irregularly-arranged, large, round shallow pits; principal flank-scales exhibiting a few broad ridges and furrows radiating from the centre to the hinder border, where they form feeble digitations; several scales much broader than deep.

Form. & Loc. Cenomanian: Kent.

P. 21, P. 6201-a. Numerous scales, various in form and state of preservation, discovered by J. Griffith and said to pertain to one fish, eight shown of the natural size in Pl. VIII. figs. 1 *a–h*; Grey Chalk, Folkestone.
Gardner Coll., and Purchased, 1890.

P. 6201 b. Large triangular bone fractured at the margin, found in association with the above. The external surface is destitute of enamel and marked with large, rounded, radiating ridges, more or less tuberculated.
Purchased, 1890.

The following specimens are not specifically determinable, but appear to belong to *Lepidotus*:—

P. 1105. Imperfect small smooth scales; Rhætic, Linksfield, Elgin.
Egerton Coll.

P. 2789. Tooth either of *Lepidotus* or *Colobodus*; Rhætic, Axmouth, Devonshire. *Enniskillen Coll.*

P. 1113. Scales; Kimmeridge Clay, Swindon, Wiltshire.
Egerton Coll.

P. 3619. Remains of trunk described as the type specimen of *Semionotus manseli*, Egerton, Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv. 1872), no. 8, pl. viii.; Kimmeridge Clay, Isle of Purbeck. Doubtfully ascribed to *Heterolepidotus* by K. A. von Zittel, Handb. Palæont. vol. iii. (1887), p. 205, and to *Lepidotus* by Woodward & Sherborn, Catal. Brit. Foss. Vert. (1890), p. 112.
Enniskillen Coll.

P. 1541. Fragments of similar fish; Kimmeridge Clay, Isle of Purbeck. *Egerton Coll.*

P. 2269. Plaster cast of imperfect fish about 0·9 in length, apparently related to *Lepidotus palliatus*; Lower Kimmeridgian (Lithographic Stone), Cirin, Ain, France.
Egerton Coll.

41800. Scale; Cambridge Greensand, Cambridge.
Purchased, 1869.

P. 7232. Nine scales; Cambridge Greensand. *Jesson Coll.*

47217. Row of four prehensile teeth on bone; Gault, Folkestone.
Gardner Coll.

P.6201. Four scales des? & fig? A.S.L. 1909, p. 161, pl. XXXV. fig. 1-4.

P.6201c. Scale. Presented by F.G. Hilton Price, Esq. 1899.

= L. laevis acc. to F. Priem, Ann. de Paléontologie, vol. iii (1908), p. 10.

P. 12153. Group of teeth of Sphærodus rugulosus, fig. Proc. Geol. Soc. vol. iv (1844), p. 384, woodc., & loc. cit.
Pres. Geol. Soc., 1911.

See Lepidotes temnurus, D. S. Jordan & J. C. Branner, Smithson. Miscell. Coll. vol. 7ii (1908), p. 12, text-figs. 6, 7.
[No value. H.A.S.]
also Lepidotes temnurus, D. S. Jordan, Peixes cretaceos do Ceará e Piauhy (Monogr. Serv. Geol. e Min. do Brasil 1923 (1921)), p. 15, pl. ii.
Lepidotes temnurus Stanmore 1938, p. 13, pl. ii. f. 3.

Lepidotus patagonicus, Ameghino.
1906. Lepidotus patagonicus, F. Ameghino, Anales Mus. Nac. Buenos Aires, vol. xv. p. 71 (name only).
1900. Lepidotus patagonicus, F. Ameghino, Anales Soc. Cient. Argentina, vol. 7. p. 217.

P. 12336. Scales & teeth; U. Cretaceous, Patagonia.
Pres. by Dr. F. Ameghino, 1900.

46407. Two dental crowns; Upper Greensand, Warminster.
Cunnington Coll.

P. 5523. Small fragmentary scales and teeth; Lower Greensand, Godalming. *Purchased*, 1888.

46383. Dental crown; Lower Greensand, Seend, Devizes.
Cunnington Coll.

47172. Group of imperfect scales; Jurassic, Nagpur, India.
Presented by Rev. Stephen Hislop, 1876.

P. 5156. Two teeth, type specimens of so-called *Sphærodus rugulosus* described and figured by Sir P. Egerton, Quart. Journ. Geol. Soc. vol. i. (1845), p. 167, with woodc.; Cretaceous, Pondicherry, Madras. *Egerton Coll.*

47885 c. Similar tooth; Cretaceous, Pondicherry, Madras.
Presented by the Hon. Robert Marsham, 1877.

P. 7420. Extremity of tail of the form named *Lepidotus temnurus* by Agassiz (Edinb. New Phil. Journ. vol. xxx. 1841, p. 83, and Comptes Rendus, vol. xviii. 1844, p. 1010, misprinted *lemnurus*); Cretaceous, Serra de Araripe, Brazil. *Purchased.*

P. 7111. Two fragments of squamation and detached scales of moderate size, exhibiting an ornament of few radiating grooves; Cretaceous, railway-cutting about two miles from Santa Amaro, Bahia, Brazil.
Presented by Joseph Mawson, Esq., 1893.

P. 7115. Less ornamented punctate scales; Cretaceous, near Lagoa Redonda Station, on the Bahia and San Francisco Railway, Timbó Branch, Brazil.
Presented by Joseph Mawson, Esq., 1893.

32580. A much-abraded head and anterior abdominal region, showing ossified hypohyals in section; Oxfordian, Dives, Vaches-noires, Normandy. *Tesson Coll.*

The following species have also been described, but most of them are unsatisfactorily defined, and they are not represented in the Collection :—

Lepidotus altaicus, J. V. Rohon, Bull. Soc. Imp. Nat. Moscou, n. s. vol. vi. (1892), p. 85, with figure.—Jurassic; River Kenderlyk, Maikantschatschai Mountains, Altai Range,

Acrolepis altaicus, Aldinger 1937 p. 258

Siberia. [Fish wanting head and extremity of tail; University Museum, Moscow.]

Lepidotus agassizi, F. A. Roemer, Verstein. Norddeutsch. Oolithengebirges, Nachtr. (1839), p. 53, pl. xx. fig. 36. Referred to *Lepidotus minor* by C. G. Giebel, Fauna d. Vorwelt, Fische (1848), p. 191.—Purbeckian (Serpulit); near Salzburg, Osterwald. [Imperfect fishes.]

Lepidotus arenaceus, O. Fraas, Württ. Jahresh. vol. xvii. (1861), p. 97, pl. i. figs. 9–11.—Keuper (Bone-bed in Kieselsandstein); Hütten, Würtemberg. [Generically indeterminable scales and jaw; Stuttgart Museum.]

Lepidotus beyrichi, W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. (1887), p. 359, pl. iv. figs. 3, 4, pl. v. fig. 2. (?) *Lepidotus spinifer*, W. Dunker, Programm Bürgerschüle Kassel, 1844, p. 41. (?) *Lepidotus spinifer*=*mantelli*, W. Dunker, Monogr. Norddeutsch. Wealdenbild. (1846), p. 63, pl. xv. fig. 9. *Lepidotus fittoni*, W. Branco (*errore*), Jahrb. preuss. geol. Landesanst. 1884 (1885), p. 181, pl. ix. fig. 2.—Wealden; Obernkirchen. [Portions of squamation; (?=*L. degenhardti*.)]

Lepidotus breviceps, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. x. (1854), p. 372, pl. xii. fig. 2.—Lower Jurassic (Kota Group); Deccan, India. [Imperfect head and scales; Geological Society of London.]

Lepidotus calcaratus, Sir P. Egerton, Palæont. Indica, [4] vol. i. no. 2 (1878), p. 3, pl. iii. figs. 2, 3.—Lower Jurassic (Kota Group); Deccan, India. [Fragments of squamation; Indian Museum, Calcutta.]

Lepidotus deccanensis, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. vii. (1851), p. 273, pl. xv.—*Ibid.* [Trunk; Geological Society of London.]

Lepidotus decoratus, A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix (1863), p. 626, pl. vi. fig. 2.—L. Kimmeridgian (Lithographic Stone); Solenhofen. [Nearly complete fish; Palæontological Museum, Munich.]

Lepidotus dentatus, F. A. Quenstedt, Flözgeb. Württemb. (1843), p. 236, and *Lepidotus* im Lias ε (1847), pl. ii. fig. 3.—Upper Lias; Boll, Würtemberg. [Imperfect fish; Tübingen University Museum.] *Hist. Foss. Ital. (1853?) p. 8. pl. iii. f. 1.*

Lepidotus exiguus, O. G. Costa, Atti Accad. Pontan. vol. viii. (1864), p. 75, pl. xi. fig. 2; F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. (1882), p. 235.—Form. & loc.?

Lepidotus arcuatus, R. H. Traquair. Poiss. Weald. Bernissart (Mém. Mus. Roy. Hist. Nat. Belg. vol. v. 1911), p. 25, text-fig. 9. — Wealden; Bernissart, Belgium. [Fragment; Mus. Brussels.]

Lepidotus bernissartensis, R. H. Traquair, loc. cit. 1911, p. 16, pl. ii. text-figs. 4–7. — Ibid. [Imperfect fishes; Roy. Mus. Nat. Hist. Brussels.] L. Casier 1960 Les Elasmobranches de Bernissart IS 36 p 28

Lepidotus brevifulcratus, R. H. Traquair, loc. cit. 1911, pl. iii. text-fig. 8. — Ibid. [Portion of trunk; Roy. Mus. Nat. Hist. Brussels.]

Lepidotes chungkingensis sp. n. Lunasic Szechuan Prov. H. T. Liu, S. L. Wang, 1961 Vert. Palas. 4 : 349, 1 f-l 1 pl.

Lepidotis, houcqui, s.n. C. Deschareaux, 1936, p 527, Cf. 1. Lias, Madagascar. [Imp. Fish].

Lepidotus congolensis, L. Hussakof, Bull. Amer. Mus. Nat. Hist. vol. xxxvii (1917), p. 761, pl. lxxxviii. figs. 6–8, text-figs. 1–7. — U. Trias(?); Mission St. Gabriel, near Stanleyville, Congo. [Scales & fragments of head-bones; Amer. Mus. N. H., New York.] Lepidotes cong. Samit-Serie 1950 Ann. Mus. Congo Belge (8) Sci. Zool. p. 12 Cf. 2. pl. 1. DE.

; B. Hauff, Palaeontogr. vol. lxiv (1921), p. 30.

L. exiguus = Notagogus pentlandi, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. xl [3] vol. xvii (1912), p. 206.

Lepidotus lusitanicus s.n. U. Cret. Portugal. W.T. Sauvage 1898 Vert. Foss. Portugal, p. 14 pl. IV. f. 2. Ann. pl. foss.

Lep. koeneni, H. Scupin, Archiv f. Naturgesch. vol. i (1896), p. 160, pl. ix. fig. 7 [structure of scale].

Lepidotus (?) lacotanus, W.K. Gregory, American Mus. Novitates 1924 No. 134 (Oct. 10); — L. Cret. ac. (Lakota Sndst.); S. Dakota. [Fish without head, in impression; Amer. Mus. N.H.]

L. Newelli sp. nov. ? U. Jurassic: Brazil R. da S. Santos 1953 Not. prelim. Est. Serv. geol. Min. Brasil No. 67 p. 1. 1 pl. [Fragm.

Lep. longidens, F. Priem, Annales de Paléontologie, vol. iii (1908), p. 12, pl. i. figs. 2, 3.

Lepidotus mannii, E. Hennig, SB. Ges. naturf. Freunde Berlin, 1913, p. 310. — U. Jurassic; Adamaua, Cameroon. Also in O. Mann & E. Hennig, Mesoz. Ablag. Adamaua, Kamerun (Beitr. geol. Erforsch. Deutsch. Schutzgeb. pt. 7, 1913), p. 12, figs. 1, 2. [Head, &.]

Lepidotus ovatus, C.R. Eastman, Mem. Carnegie Mus. vol. vi (1914), p. 404, pl. lviii. fig. 2. — Litho. Stone; Bavaria. [Fish; Carnegie Mus., Pittsburgh.]

Lepidotus frondosus, L. Agassiz, Neues Jahrb. 1832, p. 145, and Poiss. Foss. vol. ii. pt. i. (1833–44), pp. 8, 268.—Upper Lias; Zell, near Boll. [Imperfect fish; Hartmann Coll.]

Lepidotus haydeni, J. Leidy, Proc. Acad. Nat. Sci. Philadelphia, vol. viii. (1856), p. 73.—Cretaceous (?); Bad Lands, Nebraska. [Scale.]

Lepidotus intermedius, A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix. (1863), p. 627, pl. vi. fig. 3.—L. Kimmeridgian (Lithographic Stone); Solenhofen. [Nearly complete fish; Palæontological Museum, Munich.]

Lepidotus itieri, V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. (1858), p. 783 (name only), and Poiss. Foss. Bugey, pt. ii. (1873), p. 15, pl. iii. (name and figure only).—L. Kimmeridgian (Lithographic Stone); Cirin, Ain, France. [Imperfect head and anterior scales; Lyons Museum.]

Lepidotus koeneni, W. Branco, Abh. geol. Specialk. Preussen u. Thüring. Staaten, vol. vii. (1887), p. 373, pl. viii. figs. 1–4.—U. Kimmeridgian; Kahleberg, near Echte. [Trunk, wanting head, paired fins, and caudal fin; Göttingen University Museum.]

Lepidotus lævigatus, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 25.—Oxfordian; Lézinnes, Yonne, France. [Trunk wanting fins, with hinder portion of head.]

Lepidotus lennieri, H. E. Sauvage, Bull. Soc. Géol. Normandie, vol. xiv. (1892), p. 33, pl. i.—Lower Kimmeridgian; Cap de la Hève, Havre. [Imperfect fish.]

Lepidotus longiceps, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. x. (1854), p. 371, pl. xii. fig. 1.—Lower Jurassic (Kota Group); Deccan, India. [Fish wanting tail; Geological Society of London.]

Lepidotus longidens, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 608, pl. xi. figs. 1, 2.—Neocomian; Wassy, Haute Marne. [Fragment of marginal dentition.] ; Mus. Paris

Lepidotus mohimonti, T. C. Winkler, Mém. Soc. Roy. Sci. Liége, [2] vol. iv. (1874), appendix pp. 3, 4, pl. i.—Upper Lias; Saint Mard, near Virton, Luxembourg. [Imperfect fish.] (?=*L. elvensis*.)

Lepidotus oblongus, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1837–44), p. 259, pl. xxxiv. *a*. figs. 1–3; A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix. (1863), p. 625.—L. Kimmeridgian (Lithographic Stone); Solenhofen. [Fragments; Palæontological Museum, Munich.]

Lepidotus occidentalis, J. Leidy, Proc. Acad. Nat. Sci. Philadelphia, vol. viii. (1856), p. 73.—Cretaceous (?); Bad Lands, Nebraska. [Scales; Academy of Sciences, Philadelphia.]

Lepidotus pachylepis, Sir P. Egerton, Palæont. Indica, [4] vol. i. no. 2 (1878), pt. 2, p. 2, pl. i.—Lower Jurassic (Kota Group); Deccan, India. [Fragmentary head and trunk; Indian Museum, Calcutta.]

Lepidotus roemeri, W. Dunker, Monogr. Norddeutsch. Wealdenbild. (1846), p. 65, pl. xv. fig. 10.—Wealden; Bredenbeck, Deister. [Scale.]

Lepidotus similis, C. G. Giebel, Fauna d. Vorwelt, Fische (1848), p. 191.—Lower Kimmeridgian (Lithographic Stone); Solenhofen. [Indeterminable fins; Halle Museum.]

Lepidotus splendens: *Pholidophorus splendens*, C. Struckmann, Wealdenbild. Hannover (1880), p. 87, pl. iii. figs. 2–4.—Purbeckian (Serpulit); Hanover. [Imperfect fishes.]

Lepidotus striatus, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1833–44), pp. 9, 268, pl. xxxiv. *a*. fig. 4.—Chalk; Vaches Noires, Normandy. [Generically indeterminable squamation; Paris Museum of Natural History.]

Lepidotus undatus, L. Agassiz, Poiss. Foss. vol. ii. (1833–44), pt. i. pp. 9, 245, pt. ii. p. 287, pl. xxxiii.—(?) Lower Lias; Lyme Regis, Dorsetshire. [Hinder portion of fish; Paris Museum of Natural History.]

Lepidotus unguiculatus-minor, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. (1882), p. 236. *Lepidotus minor*, O. G. Costa (*errore*), Atti Accad. Pontan. vol. vii. (1853), p. 11, pl. iv. figs. 1, 2. *Lepidotus unguiculatus*, O. G. Costa (*errore*), *ibid.* vol. viii. Append. (1864), p. 111, pl. vii. figs. 2–5, 7–9.—Cretaceous; Pietraroja, Naples. [Indeterminable scales.]

Lepidotus virleti, L. Agassiz, Neues Jahrb. 1833, p. 475, and Poiss. Foss. vol. ii. pt. i. (1833–44), pp. 9, 268.—"Upper Greensand;" Morea. [Indeterminable scales, undescribed.]

A restored figure of a large fish from the Upper Jurassic of Chaux-de-Fonds, Neuchâtel, named *Lepidotus crassus*, is recorded by A. Jaccard (Bull. Soc. Sci. Nat. Neuchâtel, vol. xvi. 1888, p. 44) as having been published in the 'Rameau de Sapin,' the organ of the Club Jurassien, Neuchâtel. The present writer has not been able to obtain this publication.

Miscellaneous teeth, probably for the most part of the genus *Lepidotus*, have also been described under the following names:—

[L. M. Lambe, Contrib. Canadian Palaeont. vol. iii. pt. ii. (1902), p. 29, pl. xix. fig. 3. [Probably scales of Lepidosteus: see P. 11906, from Red Deer River, Alberta.]

Lepidotus pusillus, A. Robertson, Q. Journ. Geol. Soc. vol. iii (1847), p. 114 (name only). — Jurassic; Brora, Sutherland. [Scales.]

Lepidotus guenstedti n.s. O. Jaekel, 1929. Mon. Geol. Pal. III p. 21, fig. 21a. [U. Lias S. Holzminden].

Lepidotus piauhyensis, s.n. Roxo & Löfgren 1936° (p.?), 2 figs. Rhaetic: Piauhy, Brazil [Fish. Bonnetia]. Serv. Geol. Min. Rio. R. S. Santos 1945 Not. preliv. Div. geol. min R. de J. no 28 18 pp. 4 pls. (restor.). ? Jurassic. B. Schaeffer 1947. Bull A. M. N. H. 89 1. p. 12, pl. 1. f. U. Cretaceous. U. Triassic R. de S. Santos 1953 Not. Preliv. Estud, Div. Geol. Min. R. de J. no 7 pp. 1-4.

Lepidotus walcotti, C. R. Eastman, Proc. U. S. Nat. Mus. vol. 7ii (1917), p. 283, pl. xii. fig. 4, pl. xiii. fig. 3. — Trias; Kanab Valley, Utah. [Fragments of trunk; U. S. Nat. Mus.]

Lepidotus recorded from Cretaceous of Tendaguru, German East Africa, by E. Hennig, Archiv f. Biontologie, vol. iii (1914), p.

? Jurassic Gabon, Stromberg Schneyans° 1936°, p. 20, pls. 'Rameau de Sapin' 1872, p. 19, figs. 1-7.

Lepid.

Leiolepis kohlmanni gen. sp. nov. Muschelk
Oberfranken F. Heller 1952, Geol. Blätt. Nordost-
Bayern 2, 1, p. 25 pl 2. (Inst. Univ. Erlangen).
Alleiolepis nom. gen. nov. Kohlmanni F. Heller 1953,
Geol. Bl. Nordost. Bayern 3 2 p. 85. Lei. gen. nov.
G. P. Wilbey 1955 Australian. Zool. 12 p. 157.

Dentition of ? Lepidotes-group from L. Trias Italy
B. Accordi 1953 Ann. Univ. Ferrara N.S. sez IX
Sci. Geol.-Pal. 1 p 185 pl. i.

Palaeobergia gen. nov. type Gyr. microlepis (supra)
A.A. Malyeeva 1958. Vopr. Ikt. Acad. Sci USSR no. 11: 158 Tf. 3
(reprint) M. 5. (Palaeonisciid)

Gyr. s. A.A. Malyeeva 1958 Vopr. Ikt. Ac. Sci USSR No. 11: 157 Tf. 2 (reprint) pl. 4.
Gyrolepidotus schmidti a Palaeonisciid.
L. S. Berg 1939, C.R. Acad. URSS, n.s. 25, 633, Tf. 3
1958. Voprosy Ikthiol., Acad. URSS no 11. p. 145 Tf.
Gyrolepidotus microlepis s.n. Berg 1958 ibid p. 146.
A.A. M. = Palaeobergia supra.

Type of Lepidopterus crassus from Friedrichsroda
in the Halle Museum, seems to be Amblypterus
arcuatus, as labelled by K. von Fritsch.

May 10th. 1897.

2 specimens. P. 15094-5. B.4.6. A post-palaeoniscid
denivative near Acrodus II. 446. Woodw. 1937 Gr. p. 57
Aldinger 1937, p. 220. Lepidopterus prevc. no-name
Westollia White Moy-Thomas 1940, A. M. N. H.
(11) vi. 102.

Sphærodus (?) *cylindricoides*, F. A. Roemer, Verstein. Norddeutsch. Oolithen-gebirges, Nachtr. (1839), p. 55.—Purbeckian; Deister.

Sphærodus globulosus, Pictet & Campiche, Foss. Terrain Crét. St. Croix, pt. i. (1860), p. 73, pl. ix. fig. 7.—Middle Gault; St. Croix. [Tooth; Campiche Coll.]

Sphærodus hybridus, *subannularis*, *submammillaris*, *subradiatus*, and *tetragonus*, G. von Münster, Beitr. Petrefakt. pt. vii. (1846), p. 39.—Corallian; Lindnerberg, Hanover.

Sphærodus irregularis, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 213, pl. lxxiii. figs. 74–81; G. von Münster, Beitr. Petrefakt. pt. vii. (1846), p. 39; W. Dunker, Monogr. Norddeutsch. Wealdenbild. (1846), p. 66, pl. xv. fig. 21.—U. Jurassic; Oelingerberg, near Osnabrück, and Lindnerberg, Hanover. Wealden; Schaumburg and Ravensberg.[1] [Palæontological Museum, Munich.]

Sphærodus semiglobosus, W. Dunker, Monogr. Norddeutsch. Wealdenbild. (1846), p. 66, pl. xv. fig. 17.—Wealden; North Germany.

An indeterminable detached tooth, not of *Lepidotus*, from the Cenomanian (Plänerkalk) of Plauen, Saxony, is named *Lepidotus plauensis*? by C. E. Fischer, Allg. deutsch. Naturh. Zeit. n. s. vol. ii. (1856), p. 137, fig. 1.

The undefined name *Lepidotus cottæ* is given by Agassiz (Poiss. Foss. vol. ii. pt. i. 1844, p. 306) to unknown fossils from the "Chalk" of Hohenstein, near Schandau, Saxony. A plaster cast of a portion of Sphærodont dentition in the Enniskillen Collection (**P. 7422**) is thus named, without reference to locality.

Gyrolepidotus schmidti (J. V. Rohon, Mém. Acad. Imp. Sci. St. Pétersbourg, [7] vol. xxxvi. no. 13, 1889, p. 8, pl. i. figs. 4, 10, 13, 14) from supposed Permian in the province of Jenissei, Siberia, is described as related to *Lepidotus*; but the type specimen in the Academy of Sciences, St. Petersburg, seems to the present writer to be most probably an imperfect example of a Palæoniscid. The same remark applies to *Lepidopterus crassus* (H. Pohlig, Festschr. 70ten Geburtst. R. Leuckarts, 1892, p. 63, pl. vii. fig. 3) from the Lower Permian of Thuringia, described as a link between *Amblypterus* and the Semionotidæ. See Lawrence

[1] The Tertiary teeth noticed by Agassiz also under this name pertain to teleostean fishes.

Aethéomon Iopatini s.p.nov. = Gyrolepidotus schmidti Rohon in part Beitr. 1889 p. 15 f. 2.

Genus **DAPEDIUS,** Leach (*emend.* Agassiz).

[Trans. Geol. Soc. (2) vol. i. 1822, p. 45 (*Dapedium*), and Agassiz, Poiss. Foss. vol. ii. pt. i. 1835, p. 181.]

Syn. *Tetragonolepis,* L. Agassiz (*non* Bronn), Poiss. Foss. vol. ii. pt. i. 1833–35, pp. 6, 181.
Amblyurus, L. Agassiz, *ibid.* 1836, p. 220.
Æchmodus, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. x. 1854, p. 367.
Omalopleurus, O. G. Costa, Ittiol. Foss. Ital. 1873, p. 59.

Trunk much laterally compressed, cycloidal or very deeply fusiform. Head comparatively small, with well-developed opercular bones arranged in an arched series; operculum deeper than the suboperculum; preoperculum narrow and almost or completely covered by the suborbitals, but all the other external bones more or less ornamented with tuberculations of ganoine; a large gular plate present. Teeth robust, styliform, with simple, bifid, or mamilliform apex, arranged in clusters within the mouth. Notochord persistent; ribs ossified. Fin-fulcra large and uniserial. Paired fins small, and the pectorals situated well upon the flank; dorsal fin much elongated, arising about the middle of the back, and anal fin shorter, opposed to the hinder half of the dorsal; caudal fin slightly forked. Scales quadrangular, robust, ornamented with tubercles dorsally and ventrally, nearly smooth or similarly ornamented on the flanks, and united by a peg-and-socket articulation at a slight rib-like thickening anteriorly; scales of the flank deeper than broad, the others nearly equilateral, and the dorsal and ventral ridge-series inconspicuous.

The chondrocranium of *Dapedius* is well ossified, and there seems to have been a complete, or nearly complete, interorbital septum. As seen in side view, the basicranial axis is sharply bent upwards in front of the otic region; and the basioccipital element is deep, much excavated behind for the notochord, and longitudinally grooved below for the basicranial canal. The divisions between the elements of the cranium and the situation of the foramina for the nerves have unfortunately not hitherto been distinguished; but it is clear that there was an ossified supraoccipital, with a vertical median ridge behind, and there are robust ossifications in the prefrontal and postfrontal regions. The ethmoidal region terminates in front in a small blunt process, pierced transversely by a large foramen; it expands on each side, in advance of and below the prefrontal, into a great mass sheathed by the vomer. The olfactory nerve evidently passed through a foramen observable between the

Sapedius was by J. Greaves, 1832, Mag. N.H. V. p. 529.

Reduction of proparalum in Sapedius.
S. Wong C.R. Acad. Sci. Paris 252 1371-3, 1961.

For osteology of skull of Sapedius, see G. Allan Frost, Quart. Journ. Geol. Soc. vol. lxix (1913), p. 219, text-figs. 1, 2. [P.11177. Skull; Charmouth. Pres.? G. Allan Frost, Esq., 1913.] D.H. Rayner, 1948 Ph. Tr. R.S. 233 B. p. 307 figs 14, 15.

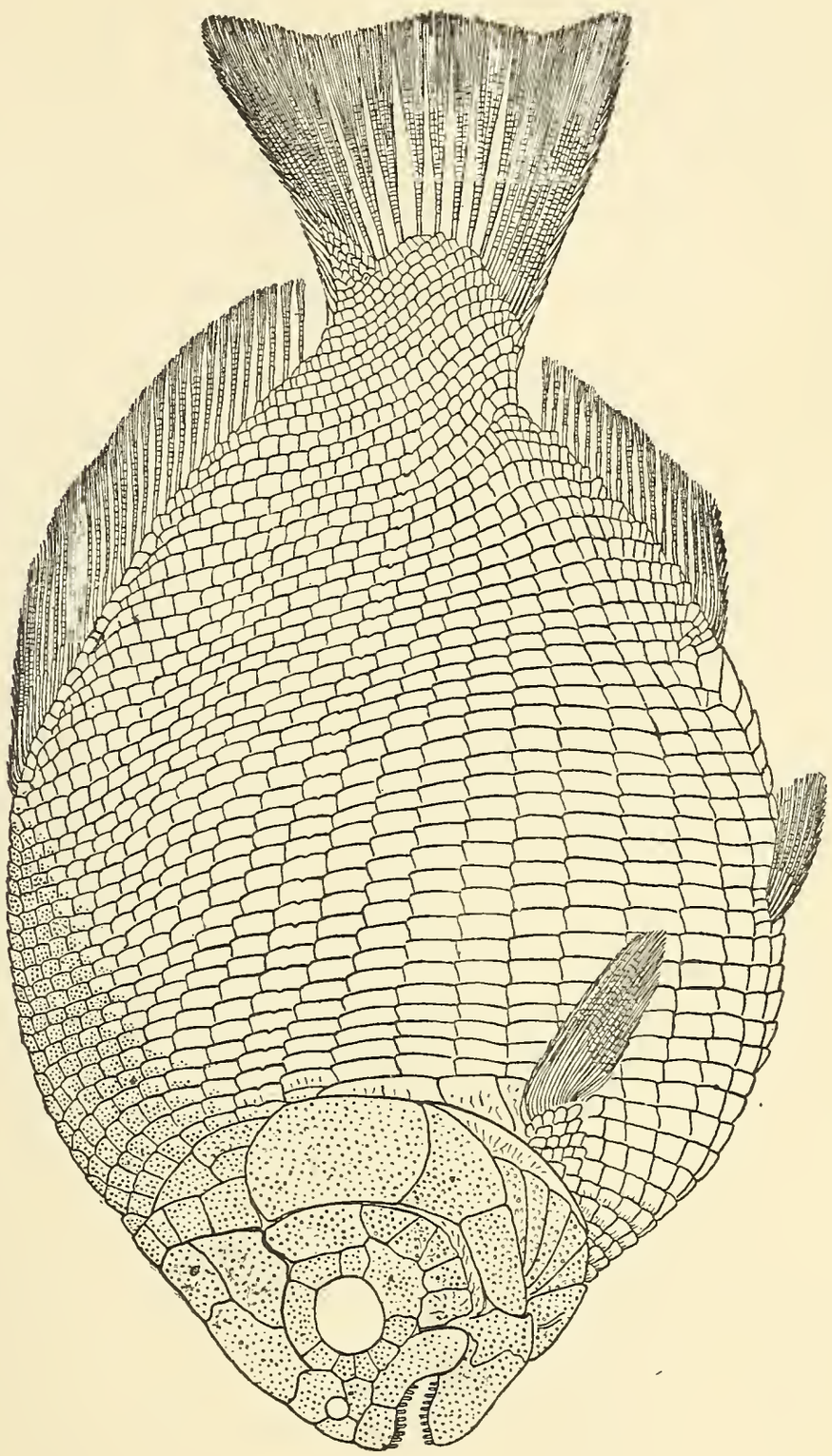


Fig. 25. *Dapedius politus*, outline restored.

prefrontal and ethmoid, there being no elongation of this foramen into a canal; and *Dapedius* thus differs from *Amia* while agreeing with *Lepidosteus* in the course of the olfactory nerves across the orbital cavity. The membrane-bones of the cranial roof form a continuous shield, without vacuities; but a narrow rim of the cranium projects behind the covering thus formed. In young individuals the paired parietals, frontals, and squamosals are distinct, and this condition sometimes persists in the adult; but more usually these principal roof-bones soon become fused into a continuous plate. Immediately in advance a pair of short and broad nasals meets in the middle line; and there is a small median plate enveloping the ethmoid in front. The premaxillæ are separate, small and short, apparently without any ascending process; the maxilla is a long stout bone, with a slight spatulate expansion posteriorly, and bounded above in its hinder two-thirds by a small, narrow supramaxilla. A complete ring of circumorbital plates surrounds the eye; and there is also an incomplete suborbital series, reaching from the squamosal to the hinder end of the maxilla, while one isolated plate occurs immediately below the nasal opening, above the suture between the maxilla and premaxilla. The parasphenoid is imperfectly known, but does not appear to have been dentigerous; the vomer, which is probably single, is furnished with a dense cluster of comparatively large teeth. The hyomandibular is elongated and much laterally compressed, with a considerable expansion above, but contracted in its lower half into a narrow bar with nearly parallel anterior and posterior edges. The symplectic and quadrate are unknown, and the palato-pterygoid arcade can only be described as delicate, with large teeth on its inferior margin, smaller tubercular teeth on its inner face. The mandible is remarkably short and deep, with a coronoid elevation, comprising distinct dentary, splenial, articular, and probably coronoid elements. The dentary bears only the marginal series of teeth, and its postero-superior portion is smooth and toothless where overlapped by the maxilla; the splenial is less deep, but more robust anteriorly, entering the mandibular symphysis and bearing a cluster of teeth, which become minute granules behind as the bone rises into the coronoid. The angular bone is deep, fixed to the outer face of the articular, and uniting with the dentary in a conspicuously zig-zag suture. Notwithstanding the prominence of the superficial ornament, the course of the sensory canals can scarcely be traced; but a groove for the transverse commissure on the parietals and squamosals is seen, and a nearly vertical groove occurs on the angular bone.

The opercular apparatus is complete, but the preoperculum is

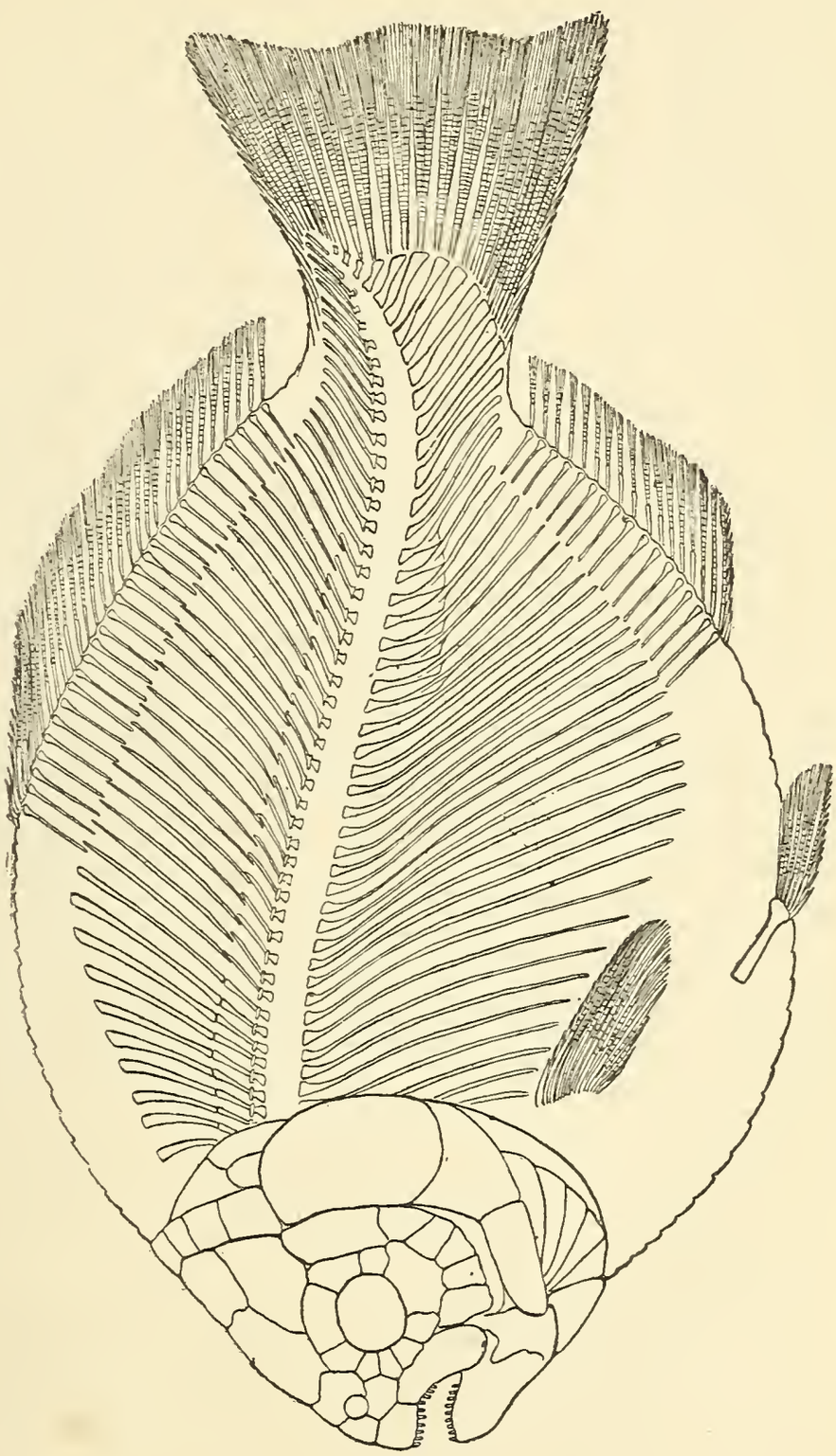


Fig. 26. Endoskeleton of trunk of *Dapedius*, restored.

only exposed on the cheek in its lower portion. The suboperculum exhibits a feeble ascending process at its antero-superior angle; and the interoperculum is relatively large. There are about six broad branchiostegal rays; and a large broadly-oval gular plate, marked by a V-shaped groove for the sensory canal, occurs in front.

In the axial skeleton of the trunk the notochord must have been persistent, and no traces of ossifications in its sheath have been detected. The neural and hæmal arches, however, are all well ossified at least superficially, and only the thickness of the squamation prevents their being frequently displayed. Throughout the trunk as far as the middle of the caudal region, the neural spines are not fused with their corresponding arches, this fusion taking place only in the hinder half of the tail. The first few neurals are especially robust, expanded at their upper end, though not supporting the stout ridge-scales, and directly apposed to their arches; the remaining neurals are more slender, taper below, and slightly overlap their arches. The ribs in the abdominal region form a regular series, but do not reach the ventral border; the hæmal spines in the caudal region are fused with their corresponding arches, are sharply bent backwards, and exhibit a small triangular expansion anteriorly at their base. There are no intermuscular bones.

All the fins bear uniserial fulcra of moderate size; but the two halves of the fin-rays at least in the median fins seem to be loosely apposed. The number of the fin-supports in the dorsal is proved to equal exactly that of the rays, and there is no fusion of supports at its origin. The paired fins are small and delicate, but nothing worthy of note is known in reference to the supports. There is a large post-temporal plate on each side articulated with the supraclavicle; and the long, arched clavicle exhibits its anterior margin sharply bent inwards.

The scales in *Dapedius* have a broad peg-and-socket articulation, but no sharply thickened rib on the inner face. The azygous ridge-scale are not acuminate, except at the origin of the anal fin, where a few are enlarged.

Most of the minor characters of *Dapedius* are very variable, and it is thus difficult to subdivide the genus into well-defined species. In the majority of forms, the scales are tuberculated only in the anterior dorsal and ventral regions; rarely the tuberculations extend over the flank. One group of species has the marginal teeth bicuspid, while another group has the same teeth unicuspid; but in observing this character it must be remembered that the former teeth when seen in side view may easily be mistaken for the latter. There are also tolerably constant differences in the form of the trunk,

Tail of *Sapediurus* described by E. L. Gill, Proc. Zool. Soc. 1923, p. 39, fig. 16.

though allowance must be made for the fact that this sometimes deepens as the individual becomes aged. On the whole, the most satisfactory classification of the species represented in the Collection appears to be as follows :—

I. Scales smooth on flanks.
  (*a*) Marginal teeth bicuspid.
    Ornament very coarse, often rugæ ; scales finely serrated ..... *politus* (p. 133).
    Variety with more closely pectinated scales ..... *radiatus* (p. 137).
    Ornament coarse, few or no rugæ ; scales not serrated ..... *orbis* (p. 137).
    Small feebly ornamented variety of the same ..... *dorsalis* (p. 138)
    Ornament fine and sparse; scales not serrated ..... *colei* (p. 140).
  (*b*) Marginal teeth unicuspid.
    Ornament coarse, sometimes rugæ; scales serrated ..... *punctatus* (p. 142).
    More elongated species, with similar ornament but more slender teeth; scales not serrated ..... *pholidotus* (p. 145).
    Still more elongated species, similarly ornamented; flank-scales scarcely deeper than broad, not serrated.... *cælatus* (p. 147).
II. Scales all tuberculated.
    Trunk about as deep as long, four-and-a-half times as deep as the caudal pedicle; teeth bicuspid; scales serrated ..... *granulatus* (p. 148).
    Equally deep trunk with more slender caudal pedicle ..... *magnevillei* (p. 151).

Dapedius politus, Leach.

1822. *Dapedium politum*, Leach, Trans. Geol. Soc. [2] vol. i. p. 45, pl. vi. figs. 1–4.
1832. *Dapedium politum*, L. Agassiz, Neues Jahrb. p. 148.
1835–36. *Dapedius politus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 185, pl. xxv. fig. 1.
1835–44. *Tetragonolepis confluens*, L. Agassiz, *ibid.* p. 199, pl. xxiii. *a.* fig. 1. [Head ; British Museum.]
1835–43. *Tetragonolepis speciosus*, L. Agassiz, *ibid.* p. 199, pl. xxiii. *b.* [Nearly complete fish ; British Museum.]
1836–44. *Tetragonolepis leiosomus*, L. Agassiz, *ibid.* p. 202, pl. xxiii. *a.* fig. 3. [Immature fish ; British Museum.]
1852. *Dapedius politus*, F. A. Quenstedt, Handb. Petrefakt. p. 202.
1854. *Dapedius politus*, J. Morris, Catal. Brit. Foss. p. 324.

1854. *Æchmodus confluens, leiosomus, speciosus*, J. Morris, *ibid.* pp. 316, 317.

1869. *Æchmodus orbicularis*, J. Morris, Geol. Mag. vol. vi. p. 337, pl. x. [Nearly complete fish; W. H. Huddleston Coll.]

1890. *Dapedius leiosomus, orbicularis, politus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, pp. 58, 59.

Type. Imperfect fish.

The type species, attaining a length of about 0·4. Maximum depth of trunk about equal to its length (exclusive of the caudal fin) and four times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying about one-quarter of the total length; the external bones in the adult ornamented with very coarse tuberculations, closely arranged, more or less flattened or even hollowed on the operculum, and often fused into short vermiculating ridges. Marginal teeth robust, partly unicuspid, partly bicuspid. Pelvic fins arising midway between the pectorals and the anal; dorsal fin with 30, and anal fin with 18 rays. Scales nearly smooth, with few minute transverse striæ and sparse punctations; the hinder border delicately serrated.

The small specimens named *Dapedius leiosomus* differ from the typical *D. politus* in their somewhat more elongated form and in the sparseness of their tubercular ornament; but they are proved to be immature by the non-fusion of the parietal, frontal, and squamosal bones. The Collection seems to exhibit every gradation between these fishes and the large specimens commonly named *Tetragonolepis confluens*.

Form. & Loc. Lower Lias: Dorsetshire.

All the following specimens were obtained from the Lower Lias of Lyme Regis, Dorsetshire:—

P. 3555. Head of large individual, with pectoral fin and anterior abdominal scales; the type specimen of the so-called *Tetragonolepis confluens* described and figured by Agassiz, *loc. cit.* *Enniskillen Coll.*

P. 3550 a. Remains of head and abdominal region of a similar fish. *Enniskillen Coll.*

P. 3556. Imperfect fish 0·39 in length, with displaced facial bones and wanting the anal fin. The ornament upon the opercular and facial bones is relatively as coarse as in the preceding specimen, but there is less tendency towards the fusion of the tubercles. The tuberculations upon the dorsal ridge-scales and the adjoining series are to a considerable extent fused into longitudinal rugæ. *Enniskillen Coll.*

Type of Æ. occidentalis pinched. Gregory, Botley
1939. (P. 24432).

P. 29408

~~173 (Mantell Cat.)~~. Remains of a fish 0·37 in length, showing only fragments of the fins. *Mantell Coll.*

P. 1575. Imperfectly preserved fish about 0·375 in length, with portions of all the fins. *Egerton Coll.*

18988. Head and much fractured trunk of a fish about 0·36 in length. The tuberculations are fused into rugæ. *Purchased*, 1845.

P. 3567. Type specimen of the so-called *Tetragonolepis speciosus*, described and figured by Agassiz. *Enniskillen Coll.*

48012. Somewhat smaller but better preserved specimen, showing broad bicuspid teeth in both jaws, and with the tubercular ornament of the head, opercular bones, and dorsal ridge-scales rarely passing into rugæ. The characters of the squamation are well exhibited. *Purchased*, 1877.

P. 3554 a. Imperfect trunk and hinder portion of head of a fish about 0·30 in length. *Enniskillen Coll.*

P. 4399. Imperfect crushed and abraded specimen about 0·32 in length, exhibiting a remarkable smoothness of part of the opercular bones. *Enniskillen Coll.*

P. 3550. Fish 0·32 in length, with imperfect fins and abraded squamation, showing both bicuspid and unicuspid teeth. The fin-fulcra are well exhibited. *Enniskillen Coll.*

35790. Specimen of the same size with caudal fin and well-preserved squamation. The head is much crushed, and there is scarcely any tendency towards a fusion of the superficial tuberculations. *Purchased*, 1860.

39846. Specimen slightly smaller than the last, wanting the greater part of the median fins. The superficial tuberculations are rarely fused into short rugæ. *Purchased*, 1866.

P. 4230, P. 4398. Two similar but more imperfectly preserved specimens. *Enniskillen Coll.*

P. 3539. Imperfect head of an equally large fish, showing jaws and dentition. *Enniskillen Coll.*

P. 3538. Another head, with extremely coarsely marked opercular apparatus. The ethmoidal plate and premaxillæ are figured in Proc. Zool. Soc. 1893, pl. l. fig. 4. *Enniskillen Coll.*

41158. Fish about 0·22 in length, with imperfect head and displaced opercular bones. *Purchased*, 1868.

19005. Similar fish, with imperfect snout. *Purchased*, 1845.

P. 1572, P. 1576, P. 1582–85. Imperfect fish about 0·21 in length, the head and trunk of a similar specimen wanting the squamation of the caudal region, the head and abdominal region of another fish, and three small specimens about 0·17 in length. *Egerton Coll.*

P. 3552. Three imperfect fishes 0·19–0·2 in length. *Enniskillen Coll.*

44858. Specimen 0·2 in length with well-preserved squamation but imperfect head and fins.
Presented by Benjamin Bright, Esq., 1873.

38530. Specimen of similar size, more imperfect. *Purchased*, 1864.

P. 6. Well-preserved fish 0·195 in length, wanting the greater part of the paired fins. *Purchased*, 1879.

P. 6335. Similar specimen with paired fins. *Beckles Coll.*

44160. Fish 0·185 in length, displaying the fins. *Purchased*, 1873.

P. 3548. Slightly smaller but similar specimen. *Enniskillen Coll.*

38106. More imperfect fish 0·165 in length. *Purchased*, 1864.

P. 3534. Type specimen of the so-called *Tetragonolepis leiosomus* described and figured by Agassiz, *loc. cit.*
Enniskillen Coll.

P. 1554 a, P. 1588 a. Two imperfect small fishes, 0·13 and 0·11 in length respectively, the second exhibiting scales in the dorsal region resembling those of *D. radiatus*.
Egerton Coll.

30864. Imperfectly preserved fish about 0·13 in length.
Purchased, 1856.

P. 3535 a, b, P. 3537. Three small specimens 0·115 to 0·12 in length, the third showing some pectinated scales in the anterior part of the dorsal region. *Enniskillen Coll.*

39867. Specimen 0·11 in length, displaying pelvic and median fins.
Purchased, 1866.

P. 4879. Comparatively well-preserved fish showing some denticulated scales. *Purchased*, 1885.

30862. Stout specimen 0·098 in length. *Purchased*, 1856.

P. 3537 a. Somewhat smaller and more elongated fish.
Enniskillen Coll.

P. 6178. Imperfect much elongated fish 0·075 in length, in counterpart. *Purchased*, 1890.

Dapedius radiatus (Agassiz).

1836–44. *Tetragonolepis radiatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 201, pl. xxiii. *a.* fig. 2.
1854. *Æchmodus radiatus*, J. Morris, Catal. Brit. Foss. p. 317.

Type. Imperfect head and trunk; British Museum.

A small species or variety differing only from the young of *D. politus* (so-called *D. leiosomus*) in the prominence of the pectinations and crenulations on all the flank-scales. Whether or not this character is due to the superficial abrasion of the scales, still remains to be determined.

Form. & Loc. Lower Lias: Lyme Regis, Dorsetshire.

P. 468. Type specimen. *Egerton Coll.*

28716. Head and lower portion of the trunk of an equally ornamented fish. *Purchased*, 1853.

35559. A partially distorted specimen 0·115 in length, with crenulated scales. *Purchased*, 1855.

35722. Another feebly ornamented specimen 0·145 in length, wanting the greater part of the head and ventral region. *Purchased*, 1859.

P. 1564. A specimen much resembling the type, but with more feebly ornamented scales and exhibiting more of the trunk. *Egerton Coll.*

P. 3537 b. Small comparatively elongated fish 0·088 in length, with ornate scales. *Enniskillen Coll.*

Dapedius orbis, Agassiz.

1836. *Dapedius orbis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 218, pl. xxv. *d.*
1849. *Dapidius orbis*, W. C. Williamson, Phil. Trans. p. 445.

Type. Fish, wanting tail.

A large species attaining a length of about 0·45. Maximum depth of trunk nearly equal to its length (exclusive of the caudal fin) and about four times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying somewhat less than one-

quarter of the total length of the fish; the external bones ornamented with numerous coarse, rounded tuberculations not fused into rugæ. Marginal teeth very stout and obtuse, the majority slightly bifid. Scales comparatively thick and nearly smooth, with few sparse punctations and extremely delicate transverse striæ; hinder border not serrated.

Form. & Loc. Lower Lias: Leicestershire.

The following specimens were all obtained from Barrow-on-Soar:—

P. 7423–24. Two fine large specimens, much fractured but exhibiting the principal characters of the species. *Purchased.*

P. 7425. A smaller more imperfect fish displaying one of the pelvic fins and some teeth. *Purchased.*

P. 7426. Very imperfectly preserved head and trunk with traces of the fins. Part of the dentition is conspicuous, the tubercles on some of the head-bones are shown in impression, and a few of the hæmal spines are exposed at the base of the caudal fin. *Purchased.*

P. 3549–a. Two small specimens, the second wanting the caudal fin and the greater part of the head, but displaying the ornament on some of the suborbital and opercular bones, many well-preserved scales, and the dorsal and anal fins. *Enniskillen Coll.*

18789. Portion of small head and trunk showing the depth of the dorsal fin. *Purchased*, 1845.

Dapedius dorsalis (Agassiz).

1836. *Tetragonolepis dorsalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 211, pl. xxi. figs. 1, 2, pl. xxi. *a.* fig. 1.

1836. *Tetragonolepis monilifer*, L. Agassiz, *ibid.* p. 212, pl. xxi. *a.* figs. 2–5. [Fish, wanting head; Bristol Museum.]

1844. *Tetragonolepis striolatus*, L. Agassiz, *ibid.* p. 304 (name only). [British Museum.]

1854. *Æchmodus dorsalis*, J. Morris, Catal. Brit. Foss. p. 316.

1854. *Dapedius monilifer*, J. Morris, *ibid.* p. 324.

1890. *Dapedius dorsalis*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 58.

1890. *Dapedius monilifer*, Woodward & Sherborn, *ibid.* p. 59.

1890. *Dapedius dorsalis*, M. Browne, Trans. Leicester Lit. & Phil. Soc. n. s., vol. ii. p. 202.

Type. Nearly complete fish; British Museum.

P.7423-26 were probably presented by Lady Aylesford, 1817.

A small species attaining a length of about 0·2. Form variable, but maximum depth of trunk usually less than its length (exclusive of the caudal fin) in the proportion of about 6 to 7, and equalling approximately three and a half times the depth of the caudal pedicle. Head with opercular apparatus occupying nearly one-quarter of the total length of the fish; the external bones almost smooth, with very few small sparse tubercles, and the operculum also exhibiting reticulated markings. Marginal teeth bicuspid and robust. Scales smooth, and the hinder border not serrated.

The young of *Dapedius orbis* being as yet unknown, it still remains uncertain whether or not the small fishes described as *D. dorsalis* should be thus interpreted.

Form. & Loc. Lower Lias: "Gloucestershire" and Leicestershire.

P. 7421. Type specimen figured by Agassiz, *loc. cit.* pl. xxi. figs. 1, 2; said to have been "found in limestone near Byrford, Gloucestershire." Possibly the locality intended is Burford Signet, Oxfordshire, where the Lower Lias occurs.
Old Collection.

P. 467. Impression of fish imperfect dorsally, figured by Agassiz, *loc. cit.* pl. xxi. *a.* fig. 1; labelled "Gloucester."
Egerton Coll.

P. 1553, P. 3532. Typical specimen in counterpart, labelled by Agassiz, and showing bicuspid marginal teeth; Barrow-on-Soar, Leicestershire. *Egerton & Enniskillen Colls.*

P. 1552. A much fractured fish, the maximum depth of the trunk 0·077 and its length (without caudal fin) 0·088; Barrow-on-Soar. *Egerton Coll.*

P. 1552 a. A large specimen 0·2 in length, having the trunk as deep as long; Barrow-on-Soar. Tubercles occur on the cranial roof, and there are bicuspid teeth in the jaw.
Egerton Coll.

P. 3530 x, P. 3531. Comparatively deep-bodied fish, 0·13 in length, in counterpart; Barrow-on-Soar. One side of the specimen is labelled "*Tetragonolepis monilifer*, Agass.," the other "*Tetragonolepis striolatus*, Agass.," both in Agassiz' handwriting. *Enniskillen Coll.*

P. 3530. Four specimens variously imperfect; Barrow-on-Soar.
Enniskillen Coll.

19430–31. A small trunk with opercular bones, in counterpart; Barrow-on-Soar. Maximum depth of trunk 0·049, and length (without caudal fin) 0·06.

Presented by the Earl of Aylesford, 1845.

40176. A very small fish displaying the reticulations on the operculum; Barrow-on-Soar. *Purchased,* 1866.

P. 7432. Small distorted fish; probably from Barrow-on-Soar.

Presented by Edward Gibson, Esq.

P. 4424. Greater portion of small fish with well-preserved pectoral fin; Barrow-on-Soar. *Enniskillen Coll.*

Dapedius colei, Agassiz.

1835. *Dapedius colei,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 195, 217, pl. xxv. *b.* figs. 1–7, pl. xxv. *c.*

Type. Imperfect head and trunk; British Museum.

A species nearly equalling *D. politus* in size. Maximum depth of trunk about equal to its length (exclusive of the caudal fin) and four times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying nearly one-quarter of the total length; the external bones feebly ornamented with fine, sparse, rounded tubercles, usually arranged on the cranial roof on the radiating lines of growth. Marginal teeth very robust, and the majority bifid. Scales smooth, comparatively thin, rarely exhibiting punctations, and apparently not serrated.

This species seems to be satisfactorily defined, but in the case of fragmentary and abraded specimens it is not always possible to distinguish between those that may be placed here and examples of *D. punctatus*, *D. orbis*, or immature *D. granulatus*.

Form. & Loc. Lower Lias: Dorsetshire.

The following specimens were all obtained from the neighbourhood of Lyme Regis:—

P. 3545. Type specimen described and figured by Agassiz, *loc. cit.* p. 195, pl. xxv. *b.* The lower marginal teeth appear to be all bifid, and the right hyomandibular bone is well exposed. The specimen is much abraded, and the opercular bones are thus unusually smooth, while the lines of growth of some of the scales are rendered conspicuous.

Enniskillen Coll.

P. 7427. A nearly complete but much fractured fish, described and figured by Agassiz, *loc. cit.* p. 217, pl. xxv. *c.*

Old Collection.

38529. Imperfect and much abraded large fish, wanting the caudal fin. *Purchased*, 1864.

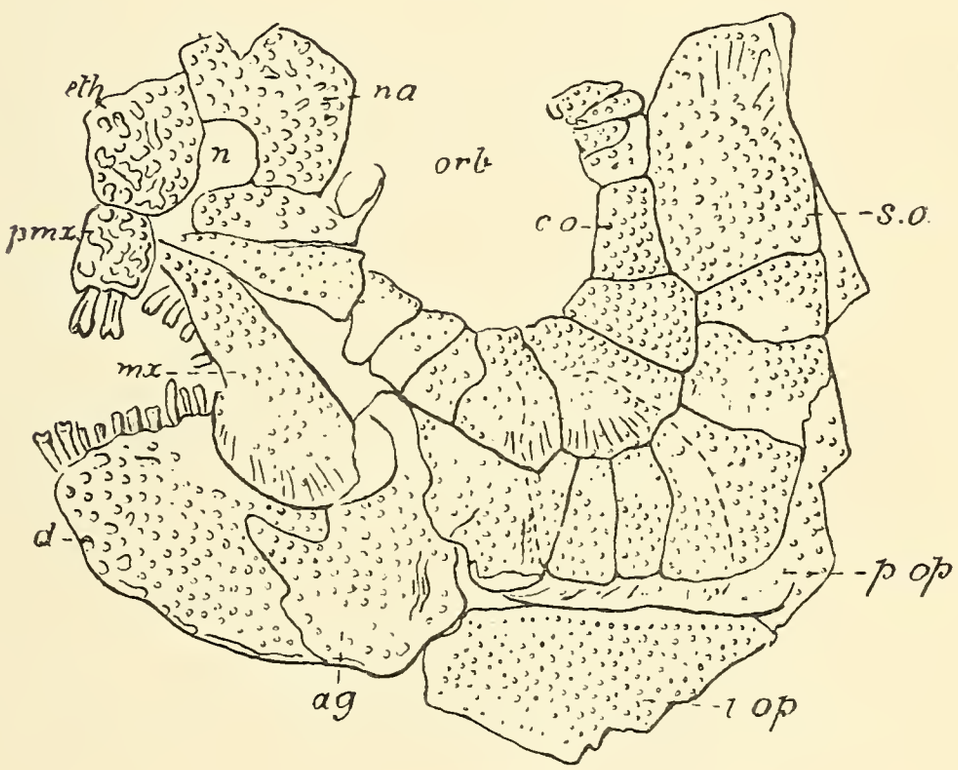
39350. Specimen 0·35 in length, much abraded but displaying some of the teeth. *Purchased*, 1864.

37785. A smaller fish exhibiting relatively large tubercles on the dorsal and ventral scales, these extending far upon the flank behind the upper portion of the operculum. *Purchased*, 1863.

P. 1569–70. Two specimens about 0·36 in length, the first much abraded and wanting the dorsal region of the trunk, the second exhibiting the extension of the tubercles upon the flank-scales as noted in no. 37785. *Egerton Coll.*

P. 3546, P. 3558. Three imperfect specimens, one showing the left pectoral fin. *Enniskillen Coll.*

Fig. 27.



Dapedius colei; facial bones of left side. [No. P. 3538 *a*.]

ag., angular; *c.o.*, circumorbitals; *d.*, dentary; *eth.*, dermo-ethmoid; *i.op.*, interoperculum; *mx.*, maxilla; *n.*, narial opening; *na.*, nasal; *orb.*, orbit; *pmx.*, premaxilla; *p.op.*, preoperculum; *s.o.*, suborbitals.

35789. A small fish 0·275 in length, somewhat abraded and broken. *Purchased*, 1860.

P. 6397. A more imperfect small specimen. *Beckles Coll.*

P. 4431. Much abraded and distorted head and trunk, showing marginal teeth, probably of this species.
Enniskillen Coll.

40651. Imperfect head displaying dentition, with left pectoral fin and some anterior scales. *Purchased*, 1867.

P. 1557. Imperfect head with opercular apparatus. *Egerton Coll.*

P. 1561. Portion of head and dentition. *Egerton Coll.*

P. 3538 a. Jaws, cheek-plates, and bones round the narial opening in natural position, shown of the natural size in fig. 27.
Enniskillen Coll.

Dapedius milloti, Sauvage.

1891. *Dapedius milloti*, H. E. Sauvage, Bull. Soc. Sci. Yonne, vol. xlv. pt. ii. p. 36, pl. iii.

Type. Nearly complete fish, apparently abraded.

A species attaining a length of about 0·3. Maximum depth of trunk nearly equal to its length (exclusive of the caudal fin) and four times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying one-third of the length to the base of the caudal fin; external bones apparently smooth. Scales all smooth. (*Sauvage.*)

Form. & Loc. Upper Lias: Vassy, Yonne, France.

Not represented in the Collection.

Dapedius punctatus, Agassiz.

1835. *Dapedius punctatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 192, pl. xxv. *a.*, pl. xxv. figs. 6 *d*, 7–9.

1833–39. *Tetragonolepis leachii*, L. Agassiz, *ibid.* pp. 7, 203, pl. xxiii. *d.* [Head; British Museum.]

1848. *Tetragonolepis striatus*, H. G. Bronn (*ex* Agassiz, MS.), Index Palæont. p. 1261.

1849. *Pholidotus leachii*, W. C. Williamson, Phil. Trans. p. 444.

1852. *Dapedius punctatus*, F. A. Quenstedt, Handb. Petrefakt. p. 202, pl. xvii. fig. 2 (in part).

1853. *Dapedius punctatus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. ix. p. 275, pl. xi. fig. 2.

1854. *Æchmodus leachi*, J. Morris, Catal. Brit. Foss. p. 316.

1854. *Dapedius punctatus*, J. Morris, *ibid.* p. 324.

(?) 1858. *Dapedius leachii*, F. A. Quenstedt, Der Jura, p. 227, pl. xxix. figs. 3, 4. pl. xxxii. fig. 7.

1890. *Dapedius leachi* and *D. punctatus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, pp. 58, 59.

Type. Nearly complete fish; Oxford Museum.

1935. ? *Sopecdus nidoti*, C. Arambourg, p. 19.

1938. D. P. Gudbrandsen, p. 28, fig. 21. (histology, plate).
1952. D. P. B. Haarløv, Hvidbjerg boring p. 24 fig. 47, 49

A species equalling *D. politus* in size. Maximum depth of trunk somewhat less than its length (exclusive of the caudal fin) and a little more than three times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying nearly one-quarter of the total length of the fish; the external bones ornamented with rounded, sharply defined tuberculations of moderate size, sometimes elongated, rarely fused into short rugæ. Marginal teeth large and unicuspid. Scales smooth, with few sparse punctations; the hinder border delicately serrated, the serrations becoming especially conspicuous in the middle of the caudal region.

The form of the operculum is apparently not constant, but in most of the specimens assigned to *D. punctatus* it is relatively narrower and deeper than in the type species.

Form. & Loc. Lower Lias: Dorsetshire. Upper Lias: Würtemberg.

Unless otherwise stated, the following specimens were all obtained from the neighbourhood of Lyme Regis :—

19486. Imperfect head and trunk, wanting the greater part of the fins, but displaying the squamation. *Purchased*, 1845.

35793. Well-preserved fish with imperfect fins. The operculum measures 0·045 in maximum depth and 0·03 in maximum width; the upper end is arched forwards, rounded, and tapering, and many of the superficial tuberculations are elongated. *Purchased*, 1860.

36258. Another fine specimen relatively more elongated (apparently by distortion). The operculum is less deep in proportion to its breadth than in no. 35793, and there is more tendency to the elongation of the superficial tuberculations. The tubercles upon the cranial roof exhibit frequent fusion into continuous series. *Purchased*, 1862.

P. 3554. Nearly complete fish 0·39 in length, with an operculum of the same form as no. 35793, more sparsely tuberculated. The marginal teeth are unicuspid, and very long though robust. The scales of the lateral line exhibit crescentic perforations; and there are traces of a superior lateral sensory canal, not perforating the scales it traverses, but passing through pairs of elongated tubercles.
Enniskillen Coll.

P. 2053. Imperfect large specimen in septarian nodule, labelled *Tetragonolepis leachi* by Agassiz. *Egerton Coll.*

P. 6396. Much fractured large specimen showing the characteristic operculum and teeth, and traces of the superior lateral line. *Beckles Coll.*

P. 3566. Fish 0·32 in length, with comparatively broad operculum. *Enniskillen Coll.*

37774. Imperfect fish about 0·33 in length. *Purchased*, 1863.

40089. Fish 0·3 in length, with abraded and fractured head-bones, but displaying the marginal teeth. *Purchased*, 1866.

42435. Head and anterior flank-scales, the type specimen of *Tetragonolepis leachi* described and figured by Agassiz, *loc. cit.* The relatively large size of the tubercles upon the bones of the snout is well shown.
Presented by Kenneth Murchison, Esq., 1872.

44859. Remains of head and anterior flank-scales.
Presented by Benjamin Bright, Esq., 1873.

P. 350. Head and abdominal region of a small individual probably of this species. Tuberculations are almost absent upon the suboperculum and the lower portion of the operculum, perhaps in consequence of abrasion; and some of the large unicuspid teeth are conspicuous. Very large median scales occur in front of the anal fin, and the vertical series of flank-scales above the base-line of this fin are slightly reflexed forwards. *Purchased*, 1881.

41214. Small fish 0·245 in length, with comparatively feeble ornament, and displaying large unicuspid teeth in the mandible. *Purchased*, 1868.

P. 3570. More imperfect small specimen. *Enniskillen Coll.*

P. 7428. Much abraded small specimen probably of this species.

18514. Imperfect head and trunk of a fish about 0·35 in length, displaying the operculum and facial bones, the marginal teeth, and a large portion of the squamation; Upper Lias, Boll, Würtemberg. *Purchased*, 1844.

P. 1592. Head vertically crushed and wanting the extremity of the snout; with some of the anterior dorsal and dorso-lateral scales. *Egerton Coll.*

P. 3540. Small head with dentition. *Enniskillen Coll.*

39144. More imperfect small head with dentition. *Bowerbank Coll.*

1832. "A fossilized fish" J. Greaves, Mag. Nat. Hist 5 p. 549, text-fig. 101.

This seems to be a good species with a rather long caudal peduncle. E.W. 14-3-52.

36883. Head wanting mandibular ramus and facial bones of the left side, displaying those of the right side from within. The outer teeth are the largest, with a simple obtuse apex, and many of the inner teeth are either indented or slightly bifid. The vomer exhibits relatively large stout teeth, and the outer edges of the pterygoid arcade and splenial are similarly armed; but on the inner face of the two latter elements the teeth are merely small tubercles, The epihyal is much contracted at its proximal end, and the ceratohyal is remarkably short and deep.

Purchased, 1862.

P. 1589. Remains of mandible and portions of surrounding bones.

Egerton Coll.

Dapedius angulifer (Agassiz).

1832–33. *Tetragonolepis trailli*, L. Agassiz, Neues Jahrb. 1832, p. 147, and Poiss. Foss. vol. ii. pt. i. p. 7.

1835–36. *Tetragonolepis angulifer*, L. Agassiz, *ibid.* p. 213, pl. xxii.

1854. *Æchmodus angulifer*, J. Morris, Catal. Brit. Foss. p. 317.

Type. Nearly complete fish.

A species attaining a length of about 0·5. Maximum depth of trunk not quite equal to its length (exclusive of the caudal fin) and somewhat more than three and a half times as great as the depth of the caudal pedicle. Marginal teeth unicuspid. Scales of flank smooth, none much deeper than broad, and each marked externally with a triangular depression of which the base coincides with the hinder border while the apex is turned forwards. (*Agassiz.*)

Form. & Loc. Lower Lias: Stratford-on-Avon, Warwickshire.

Known only by the unique type specimen, which cannot now be traced.

Dapedius pholidotus, Agassiz.

1832. *Tetragonolepis pholidotus*, L. Agassiz, Neues Jahrb. p. 147.

(?) 1832. *Tetragonolepis heteroderma*, L. Agassiz, *ibid.* p. 147.

1833–44. *Tetragonolepis pholidotus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 7, 207, pl. xxiii. *e.* fig. 2.

(?) 1833–44. *Tetragonolepis heteroderma*, L. Agassiz, *ibid.* pp. 7, 206, pl. xxiii. *e.* fig. 1. [Portion of squamation; Hartmann Coll.]

1843. *Tetragonolepis pholidotus*, F. A. Quenstedt, Flözgeb. Württemb. p. 238.

1852. *Dapedius pholidotus*, F. A. Quenstedt, Handb. Petrefakt. p. 203, pl. xvii. figs. 1, 3–5.

1854. *Æchmodus pholidotus*, J. Morris, Catal. Brit. Foss. p. 317.

1858. *Dapedius pholidotus*, F. A. Quenstedt, Der Jura, p. 228, pl. xxxi. figs. 1–7.

1860. *Tetragonolepis pholidotus*, A. Wagner, Sitzungsb. k. bay. Akad. Wiss. p. 41.

Type. Imperfectly preserved fish; Stuttgart Museum.

A small species, attaining a length of about 0·25–0·3. Maximum depth of trunk three-quarters as great as its length (exclusive of the caudal fin) and equalling nearly four times the depth of the caudal pedicle. Head with opercular apparatus occupying one-quarter of the total length of the fish; the external bones ornamented with numerous large, rounded tuberculations, sometimes fused into short rugæ on the cranial roof and facial bones. Marginal teeth unicuspid and comparatively slender. Scales smooth or faintly wrinkled in the anterior half, and the hinder border not serrated; tuberculations absent on all the ventral scales except the ridge-series, where they are represented chiefly by elongated rugæ.

Form. & Loc. Upper Lias: Würtemberg and Normandy, Sw. B 1?

36049. Typical specimen about 0·275 in length, wanting the bones on the exposed left side of the head, the paired fins, the dorsal fin, and the greater part of the anal fin; Lias ε, Metzingen, near Reutlingen. *Purchased*, 1861.

P. 1574 a, P. 1563 b, c, P. 1573. A similar specimen showing the marginal teeth and part of the cranial roof; also two very imperfect fishes wanting the dorsal region and a fragmentary small specimen; Ohmden, near Boll.
Egerton Coll.

P. 3568–9. Three large fishes with imperfect fins, all showing part of the dentition and one well displaying the squamation; also remains of a small head, with the impression of some anterior scales and a pectoral fin; Ohmden.
Enniskillen Coll.

P. 4401. Another imperfect large fish, exhibiting an inner view of the left opercular and branchiostegal apparatus; Ohmden.
Enniskillen Coll.

18512. Head and the greater part of the squamation of a large individual; Ohmden. Some of the teeth and the superficial ornament are well shown. *Purchased*, 1844.

19660–61. Two very imperfect fishes, exhibiting part of the superficial ornament and a large portion of the squamation; Boll. *Purchased*, 1845.

1896. Dapedius pholidotus, H. Sauvin, Archiv f. Naturgesch. vol. i. p. 167 [structure of scale].

1921. Dap. pholidotus, B. Haxff, Palaeontogr. vol. lxiv. p. 30, pl. xx. fig. 3.

1937. Dapedius, T.S. Westoll, p. 373, tf. 76. (P. 1557).

1942. Dapedius pholidotus, E. Kuhn, Sci. geol. Helv. 34 p. 297 fig. 1.

1952. D. p. B. Haxff Verhandel Nat p. 24 pl. 4b

1952. K. C. B. Hartoff, Holzmarkt-Zeitschrift f. 24, H. 408.

22525. Remains of head and abdominal region, with the pectoral fin and some of the superficial ornament in impression; Boll. *Purchased*, 1848.

P. 1563 d. Portion of squamation; Boll. *Egerton Coll.*

The following specimens bear the specific name of *Dapedius ovalis* (*Tetragonolepis ovalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1836, p. 209, pl. xxi. fig. 3), and were also referred to the genus *Æchmodus* by Egerton (J. Morris, Catal. Brit. Foss. 1854, p. 317). They seem to differ only from *D. pholidotus* in the slightly more elongated form of the trunk, and are regarded as constituting a variety of this species by Quenstedt (Handb. Petrefakt. 1852, p. 203).

P. 1563 a. Type specimen of *D. ovalis* described and figured by Agassiz, *loc. cit.*; Boll. *Egerton Coll.*

P. 3572. Head and trunk of a fish about 0·22 in length, wanting the caudal pedicle and fin, labelled by Agassiz; Ohmden. *Enniskillen Coll.*

P. 1563 e. Specimen 0·17 in length, chiefly shown as an impression; Boll. *Egerton Coll.*

P. 3571. Impression of slightly larger fish, labelled by Agassiz; Ohmden. *Enniskillen Coll.*

32448. Fine specimen about 0·145 in length to the base of the caudal fin, wanting the greater part of the fins; Upper Lias, Curcy, Normandy. The parietal, frontal, and squamosal bones are separate. *Tesson Coll.*

Dapedius cælatus, Quenstedt.

1858. *Dapedius caelatus*, F. A. Quenstedt, Der Jura, p. 226, pl. xxviii. figs. 1, 2.

1860. *Tetragonolepis caelatus*, A. Wagner, Sitzungsb. k. bay. Akad. Wiss. p. 40.

Type. Nearly complete fish; Tübingen University Museum.

An elongated species, attaining a length of about 0·45. Length of trunk (exclusive of the caudal fin) one and a half times as great as its maximum depth, and the latter equalling thrice the depth of the caudal pedicle. Head with opercular apparatus occupying somewhat less than one-quarter of the total length of the fish; the external bones ornamented with very coarse rounded tubercles, usually fused into short rugæ, which are directed nearly horizontally

on the opercular and cheek-plates. Teeth robust, unicuspid in the marginal series of the mandible. Tubercles on the dorsal and ventral scales very coarse and usually fused into rugæ; the scales of the flank scarcely deeper than broad, not serrated, and covered with smooth enamel, which exhibits a coarse rugosity or digitation towards the anterior border.

Form. & Loc. Upper Lias: Würtemberg.

19659. Fish about 0·43 in length, with very imperfectly preserved head and abdominal region, but displaying the general form and proportions and some of the scales; Boll. *Purchased*, 1845.

19659 a. More imperfect fish, in counterpart, exhibiting the squamation, the operculum and suboperculum, remains of some of the head-bones, and the lower marginal teeth; Boll. *Purchased*, 1845.

P. 7429. Similar specimen with well-preserved scales and opercular bones. *Purchased.*

P. 2015–6. Two imperfect specimens. *Egerton Coll.*

Dapedius granulatus, Agassiz.

1835. *Dapedius granulatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 190, pl. xxv. figs. 2–6.

1836–43. *Tetragonolepis pustulatus*, L. Agassiz, *ibid.* p. 201, pl. xxiii. *c.* [Anterior portion of fish; British Museum.]

1849. *Dapidius granulosus*, W. C. Williamson, Phil. Trans. p. 445, pl. xl. figs. 5, 6.

1854. *Æchmodus pustulatus*, J. Morris, Catal. Brit. Foss. p. 317.

1888. *Dapedius cycloides*, W. Deecke, Mittheil. Comm. Geol. Landes-Unters. Elsass-Lothringen, vol. i. p. 209, pl. iii. [Nearly complete fish; collection of Herr Fürst, Ruprechtsau, near Strassburg.]

1890. *Dapedius granulatus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 58.

Type. Imperfect head and anterior abdominal region; Oxford Museum.

The largest known species, attaining a length of 0·6. Maximum depth of trunk equalling or slightly exceeding its length (exclusive of the caudal fin) and about four and a half times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying one-quarter of the total length of the fish; the external bones ornamented with numerous coarse, rounded tuberculations, very rarely fused into rugæ. Marginal teeth stout, the majority

obtuse and slightly bifid. Scales of the abdominal and part of the caudal region all ornamented at least in their anterior half with coarse tuberculations, which are often flattened, closely arranged, and in part fused into rugæ; hinder border conspicuously serrated in young specimens, smooth or nearly so in adults.

The type specimen of the so-called *D. cycloides* was obtained from the "Angulatus-kalk" of Steinburg, near Zabern, Lower Alsace.

Form. & Loc. Lower Lias: Dorsetshire and Alsace-Lorraine.

All the following specimens were obtained from the neighbourhood of Lyme Regis, Dorsetshire :—

P. 3561. Type specimen of the so-called *Tetragonolepis pustulatus*, described and figured by Agassiz, *loc. cit.* Remains of the head and anterior abdominal squamation are shown, but teeth are wanting. *Enniskillen Coll.*

19004 a. Remains of the head and greater portion of the trunk of a large fish probably about 0·6 in length. From the Johnson Collection, noticed by Agassiz, *op. cit.* vol. ii. pt. i. p. 201. *Purchased*, 1845.

40351. Large specimen, much elongated by distortion and displaying the caudal fin. *Purchased*, 1867.

P. 5937. Fine specimen 0·55 in length, showing the obtuse, bifid marginal teeth. The scales are not serrated, and many of the tubercles on the flank are fused into short rugæ. *Purchased*, 1889.

P. 3563. Well-preserved fish about 0·475 in length. As in the former specimen, none of the scales exhibit serrations. *Enniskillen Coll.*

P. 3564. An equally large imperfect fish displaying the dorsal and caudal fins. The tuberculations upon the cranial roof and flank-scales are partially fused into short rugæ. *Enniskillen Coll.*

P. 3564 a. Imperfect head and trunk wanting the dorsal region; the ornament consisting of rounded tubercles, rarely fused except on the ridge-scales. *Enniskillen Coll.*

P. 3562. Imperfect and distorted remains of the head and abdominal region of an equally large fish. *Enniskillen Coll.*

P. 3564 b. Fragmentary trunk with skull. *Enniskillen Coll.*

P. 1577. Fine specimen 0·42 in length. *Egerton Coll.*

35791. More imperfect fish of the same size, exhibiting some of the flank-scales from the attached face. *Purchased*, 1860.

P. 420. Much-broken and abraded fish, equally large.
Presented by F. Seymour Haden, Esq., 1882.

36046. Imperfect head and anterior scales of a similar fish.
Purchased, 1861.

P. 3544, P. 3565. Two specimens about 0·4 in length, the first wanting the greater part of the fins, the second having lost much of the scale-ornament by abrasion.
Enniskillen Coll.

32494. Similar fish much crushed and distorted in the dorsal portion. *Purchased*, 1857.

P. 7430. Imperfectly preserved fish 0·35 in length, wanting the greater part of the dorsal and anal fins. *Purchased.*

P. 1578. Equally large specimen, somewhat abraded and distorted, but with well-preserved median fins and the lower marginal teeth. *Egerton Coll.*

40650. A smaller specimen, shortened by crushing, displaying the fulcra of the right pelvic fin. *Purchased*, 1867.

P. 1579. Small head and trunk, much abraded, without fins.
Egerton Coll.

P. 6063. Remains of branchiostegal rays, the left clavicle, and a well-preserved portion of the anterior ventro-lateral squamation of a large fish, showing the partial fusion of the ornamental tubercles into rugæ.
Presented by F. Harford, Esq., 1889.

35794. Abraded remains of the head and abdominal region of a small individual, probably about 0·27 in length, exhibiting the serration of the hinder margin of the scales.
Purchased, 1860.

P. 4400. Well-preserved head and abdominal region of a small individual. *Enniskillen Coll.*

P. 1555. Much abraded and fractured small head and abdominal region, remarkable for the fineness of the granulation on the opercular bones. *Egerton Coll.*

Dapedius magnevillei, Agassiz.

1833–36. *Tetragonolepis magneville,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 7, 214, pl. xxiv.

1852. *Dapedius magneville,* F. A. Quenstedt, Handb. Petrefakt. p. 203.

Type. Nearly complete fish; Caen Museum.

A species of moderate size. Maximum depth of trunk equal to its length (exclusive of the caudal fin) and about six times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying much less than one-quarter of the total length of the fish; the external bones ornamented with distinct tuberculations. All the scales, except those towards the end of the tail, ornamented with sparsely arranged tubercles.

Form. & Loc. Upper Lias: Normandy.

P. 7431. Very imperfectly preserved fish, about 0·33 in length; said to have been obtained from Caen, but probably from Curcy. *Tesson Coll.*

As already pointed out (A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. i. 1888, p. 356), vertically crushed specimens of *Dapedius* form the basis of the so-called genus *Amblyurus* (L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1836, p. 220). A single species, *A. macrostomus* (Agassiz, *ibid.* p. 220, pl. xxv. *e*), is founded upon specimens from the Lower Lias of Lyme Regis, now in the Oxford Museum; and the following are similar fossils which can only be generically determined:—

35564, 35788. Two crushed and distorted fishes showing ventral aspect, the first small, the second large and displaying bifid teeth; Lower Lias, Lyme Regis. *Purchased,* 1860.

36338. Another example, ventral aspect, wanting tail but showing bifid teeth; Lyme Regis. *Purchased,* 1862.

P. 1562. Similar specimen, showing paired fins and uniserial fulcra; Lyme Regis. *Egerton Coll.*

P. 3574. Two more fragmentary specimens, ventral aspect, showing the caudal fin; Lyme Regis. *Enniskillen Coll.*

P. 2024. More imperfect smaller example, labelled by Agassiz; Lower Lias, Street, Somersetshire. *Egerton Coll.*

The following fragmentary specimens of *Dapedius,* though also specifically indeterminable, are of interest as illustrating anatomical characters or showing the distribution of the genus:—

P. 1587. An imperfect much elongated fish, displaying the neural and hæmal arches of the trunk and the pelvic fin-supports, partly used in the restoration, fig. 26, p. 131; Lower Lias, Lyme Regis. *Egerton Coll.*

P. 3542–a. Two fragmentary heads, with some anterior scales, displaying the mandible, &c., from below; Lyme Regis. *Enniskillen Coll.*

P. 3541. Fine cranium, described and figured by the present writer in Proc. Zool. Soc. 1893, p. 564, pl. l. fig. 3; Lyme Regis. *Enniskillen Coll.*

P. 1535. Laterally-compressed cranium showing vomerine teeth, with anterior neural arches of trunk exhibiting the separate, distally expanded neural spines; Lyme Regis (?). The spines, so far as preserved, are directly apposed to, and do not overlap, the neural arches. *Egerton Coll.*

P. 1537 a. Very small cranium, side view; Lyme Regis. *Egerton Coll.*

P. 1589 a. Imperfect right maxilla, premaxilla, and dentary; Lyme Regis. *Egerton Coll.*

P. 3551. More remains of jaws; Lyme Regis. *Enniskillen Coll.*

P. 4877. Fine right mandibular ramus, inner aspect, showing both dentary and splenial entering the symphysis; Lyme Regis. The splenial teeth are mammillated. *Purchased*, 1885.

P. 1536, P. 1557 a. Two more imperfect left mandibular rami; Lyme Regis. As in the previous specimen, the splenial has the appearance of being forked behind and rising into the coronoid process. *Egerton Coll.*

P. 4423. Imperfect small fish displaying the axial skeleton of the trunk; Lyme Regis. The neural spines are free as far as the middle of the caudal region, but then become fused with the corresponding arches. The ribs, though robust, do not extend to the ventral border of the trunk. The hæmal spines in the caudal region meet their supporting arches at a considerable angle, are fused with them, and exhibit a small triangular expansion anteriorly below the point of union. *Enniskillen Coll.*

P. 1556 a. Portion of trunk showing ribs, neural arches, and the inner aspect of the squamation; Lyme Regis. *Egerton Coll.*

P. 515. Des? A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii (1898), p. 456.

D. sp. aff. costae, K. G. Krambarger, 1905, Beitr. Pal. Österr.-Ungarns, XVIII, p. 215, [illegible] pl. xxxi (V) fig. 3. U. Trias. Hallein (Post Sqamm).

D. costai T. Busani 1856 Pal. Ital. 1 p. 197 pls. figs.

P. 1592. Anterior fragment of fish displaying broad, ornamented dorsal ridge-scales, each apparently the result of the fusion of about three pairs of scales with the median one; Lyme Regis (?). *Egerton Coll.*

P. 515. Fragment of squamation labelled *Dapedius micans* by Agassiz and intended to be the type specimen of that species, named in list in Poiss. Foss. vol. ii. pt. i. (1844), p. 304; Upper Lias, Whitby. The scales are abraded and exhibit slight transverse rugæ. *Egerton Coll.*

P. 1591. Fragment probably of the same species, showing scales and remains of highly-ornamented head-bones, on which the tubercles are considerably fused into rugæ; Whitby. Two imperfect large teeth seem to have been simply pointed. *Egerton Coll.*

P. 3536. Fragment apparently of similar squamation, labelled *Dapedius micans* by Agassiz; Whitby. *Enniskillen Coll.*

P. 3543. Imperfect small trunk with part of the coarsely tuberculated opercular apparatus; Upper Lias, Ilminster, Somersetshire. The scales are nearly smooth, without tuberculations or posterior serrations. *Enniskillen Coll.*

The following species have also been founded upon fragmentary specimens, but there are no examples in the Collection:—

Dapedius alpinus, G. G. Winkler, Neues Jahrb. 1886, vol. ii. p. 20, pl. ii. fig. 6.—Rhætic; Länggries, Bavarian Alps. [Fragment of head and abdominal scales.] (? *Colobodus*.)

Dapedius bouei: *Tetragonolepis bouei*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 7, 210 (1833–36), pl. xxii. fig. 1.—Rhætic; Seefeld, Tyrol. [Indeterminable fragment.]

Dapedius costai, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. (1892), no. 3, p. 9: *Omalopleurus speciosus*, O. G. Costa, Ittiol. Foss. Ital. (1873), p. 59, pl. v. fig. 1.—Triassic: Giffoni, near Naples. [Imperfect head and abdominal region; Geological Museum, University of Naples.]

Dapedius egertoni, W. H. Sykes, Quart. Journ. Geol. Soc. vol. ix. (1853), p. 352; Sir P. Egerton, Palæont. Indica, ser. iv. vol. i. no. 2 (1878), p. 6, pl. ii. figs. 3–5: *Æchmodus egertoni*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. x. (1854), p. 367.—Lower Jurassic (Kota Formation); Kota, Deccan, India. [Fragments; Geological Society of London.]

Dapedius jugleri, F. A. Roemer, Verstein. Norddeutsch. Oolithen-Geb., Nachtr. (1839), p. 53, pl. xx. fig. 35.—Upper Lias; Werther, Westphalia. [Head and anterior scales.]

Dapedius notabilis: *Tetragonolepis notabilis*, A. Wagner, Sitzungsb. k. bay. Akad. Wiss. 1860, p. 40 (footnote): *Dapedius punctatus*, F. A. Quenstedt (*errore*), Der Jura (1858), p. 226, pl. xxvii. figs. 4–12, pl. xxviii. figs. 3, 4, pl. xxix. figs. 1, 2.—Upper Lias; Würtemberg. [Fragments; Tübingen University Museum.]

Dapedius olifex, F. A. Quenstedt, Der Jura (1858), p. 89, pl. xi. figs. 18–26.—Upper Lias; Würtemberg. [Skull and fragments; Tübingen University Museum.]

The undefined name *Dapedius arenatus* was given by Agassiz (Poiss. Foss. vol. ii. pt. i. 1844, p. 304) to an unknown fossil from the Lower Lias of Lyme Regis. An imperfect example, apparently of *D. colei*, in the Egerton Collection (**P. 1568**), is thus labelled by him.

Here may also perhaps be placed the teeth from the Lower Lias of Lyme Regis recorded under the undefined name of *Sphærodus microdon*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 216 (name only).

An imperfectly defined Upper Jurassic genus, closely related to *Dapedius*, is named *Heterostrophus* [1] (A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 614), and is known by a single species, *H. latus* (A. Wagner, *ibid.* p. 615), from the Lower Kimmeridgian (Lithographic Stone) of Solenhofen, Bavaria. The type specimen is preserved in the Palæontological Museum, Munich, and measures about 0·33 in length to the base of the caudal fin. The external bones and scales are smooth, and the comparatively stout and small inner teeth are marked on the crown with radiating grooves. Fragmentary evidence probably of a similar fish from the Oxford Clay of Peterborough is preserved in the collection of Alfred N. Leeds, Esq., Eyebury.

1928
Heterostrophus phillipsi, S.Nr. H.S. Woodward, Précis Peterborough Nat. Hist. Soc. & Lvt. (1927) pp. 59-60 pls. I-V. - Oxf. Clay; Peterboro. Simp. fish; Mus. Peterb. N.H.S.]

Genus **CLEITHROLEPIS,** Egerton.

[Quart. Journ. Geol. Soc. vol. xx. 1864, p. 3.]

Trunk much laterally compressed, very deep, and the dorsal border strongly arched. Head comparatively small, with well-developed opercular bones arranged in an arched series; operculum

[1] Printed *Heterostichus* in Gelehrte Anzeig. k. bay. Akad. Wiss. 1860, p. 93.

Dap. punctatus, H. Scupin, Archiv f. Naturgesch. vol. i (1896), p. 167, pl. x. fig. 2 [structure of scale].

Dapedius? inornatus, J. Henry, Mém. Soc. d'Emulat. Doubs [4] vol. x (1876), p. 417, pl. ii. fig. 25. — Rhætic; [Scale only.]

Amblyurus novus, J. Henry, loc. citt. 1876, p. 417, pl. ii. fig. 26. — Rhætic; Boirset. [Scale only.]

Cf. Homoeolepis suborbiculata, C. R. Eastman, Mem. Carnegie Mus. vol. vi (1914), p. 403, pl. lviii. fig. 3. — Litho. Stone; Bavaria. [Fish; Carnegie Mus., Pittsburgh.]

Spaniolepis ovalis, n.g., n.s., K. G. Kramberger, 1905, Beitr. Pal. Öst.-Ungarns XVIII. p. 216, f.f. 15-16, pl. xx (iv) f. 6-8. U. Trias (? Rhæt.): Hallein - [Fishes] Geol. Stn. Bergakad.; Leoben.

preocc. Kolbe 1894 (Col.). = Dandya W. T. M. T. 1941 a.m.n.h. (ii) 1 p. 399.

= P. 10748. Parkd. 1909.

Heterostrophus latus (H. phillipsi) descr. fish. A. S. Woodward, 1929. P.Z.S. pp. 561-6.

Cleithrolepsis (sic) brückneri, n.s. G.F. Bertle, 1981, Bol. Min. G.P. pl. 6. p. 297 1. fig. Trios: Coburg. [Fish: Naturw. Mus., Coburg].

1935. C. granulata, R.T. Wade; p. 49, Hfs. 22-27, pl. vi. f. 3. (w. Otter refs.).

much less deep than the suboperculum, the preoperculum narrow and almost covered by the suborbitals; the external bones more or less ornamented with superficial tuberculations of ganoine. Marginal teeth styliform, in close regular series. Fin-fulcra large and uniserial. Pectoral fins large, situated well upon the flank, pelvic fins smaller; dorsal and anal fins remote and opposite, not much elongated; caudal fin forked. Scales quadrangular, robust, very deep on the flank, more or less tuberculated, and the anterior border strengthened by a robust inner rib, which forms the peg-and-socket articulation; the series between the dorsal and anal fins sharply turned forwards for a short space above and below; dorsal and ventral ridge-scales conspicuous.

Cleithrolepis granulatus, Egerton.

1864. *Cleithrolepis granulatus,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xx. p. 3, pl. i. figs. 2, 3.

1890. *Cleithrolepis granulatus,* A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 39, pl. vii., pl. viii. figs. 2, 3.

1890. *Cleithrolepis granulatus,* O. Feistmantel, *ibid.* no. 3, p. 75, pl. xxix. fig. 8.

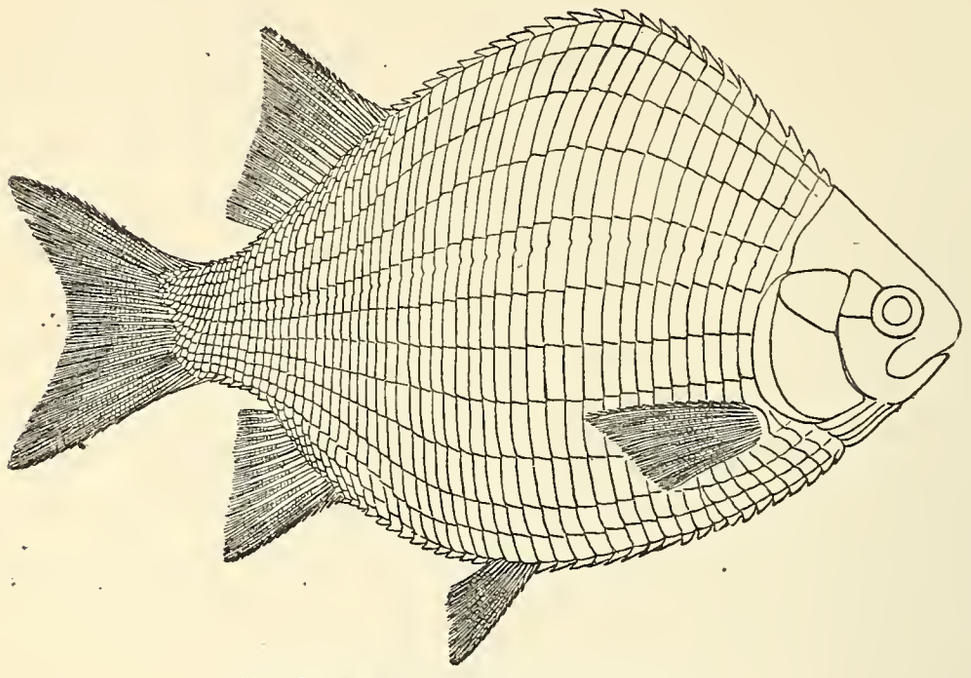
Type. Nearly complete fish.

The type species, attaining a length of about 0·15. Maximum depth of trunk about equal to its length (exclusive of the caudal fin) and somewhat more than four times as great as the depth of the caudal pedicle. Head with opercular apparatus occupying less than one-fifth of the total length of the fish, and its height at the anterior margin of the operculum contained slightly more than two-and-a-half times in the maximum depth of the trunk; depth of operculum only half that of the suboperculum, which is twice as deep as broad. External bones and scales finely and closely tuberculated. Pelvic fins arising midway between the pectoral and anal fins; dorsal fin, with about 17 rays, arising at the commencement of the posterior third of the trunk; anal fin arising more posteriorly but terminating at the same point, and comprising not more than 12 rays. Flank-scales very deep, some of those of the lateral line five or six times as deep as broad, none serrated on the hinder border; the vertical series on the caudal region rapidly narrowed; ridge-scales apparently not crenulated.

Each ventral ridge-scale is shown in several specimens to consist of a right and left half, apparently meeting at a very obtuse angle in the median line; and it is thus evident that the lower portion of the abdomen was broad during life. The fish is, indeed, of so remarkable a form that the fossilized examples are very variously

distorted, and it is difficult to determine its original shape and proportions. The accompanying woodcut (fig. 28) is probably almost correct.

Fig. 28.



Cleithrolepis granulatus, restored.

A unique specimen with remarkably deepened trunk, found in association with this species, is provisionally named *Cleithrolepis altus* (A. S. Woodward, *loc. cit.* p. 42, pl. viii. fig. 4).

Form. & Loc. Upper Trias (Lower Hawkesbury-Wianamatta Series): New South Wales.

P. 6280. Four imperfect specimens; Gosford. *By exchange*, 1890.

P. 6281. Slab exhibiting imperfect specimens in association with *Pristisomus*, &c.; Gosford. *By exchange*, 1890.

Cleithrolepis extoni, A. S. Woodward.

1888. *Cleithrolepis extoni*, A. S. Woodward, Quart. Journ. Geol. Soc. vol. xliv. p. 141, pl. vi. figs. 6, 7.

Type. Imperfect fish; British Museum.

A species apparently resembling the type in form and proportions, but differing in the relative size of the opercular bones. Tuberculations on head and opercular bones fine and sparse; operculum two-thirds as deep as the suboperculum, which is nearly as broad as deep.

Form. & Loc. Upper Karoo Formation (Stormberg Beds): Orange Free State.

P. 5455. The type specimen, described and figured *loc. cit.* p. 141, pl. vi. fig. 6; Rouxville.

Presented by Hugh Exton, Esq., M.D., 1888.

1935. *Cleithrolepis alta*, R.T. Wade, p. 57, pl. 28.

1909. *Cleithrolepis extoni*, R. Broom, Ann. S. Afr. Mus. vol. vii. p. 264.

Cleithrolepis minor, Broom.

1909. Cleithrolepis minor, R. Broom, Ann. S. Afr. Mus. vol. vii. p. 266, pl. xiii. fig. 9.

1931. Cleithrolepis minor, J. Brough, P.Z.S. p. 267, t-f. 13

? Ch. cuyana o.n. Trias: Argentina, a. f. Bordas 1944, Physis 19 p. 457 - pl. ii f. 1.

Dipteronotus re-described by A.S.W., Proc. Geol. Assoc. XXI. (1910) p. 322.

Hydropessum Kannemeyeri, R. Broom, Ann. S. Afr. Mus. vol. vii. p. 266, pl. xii. fig. 5. — Upper Karoo; a Perleidid nep. 57. [Imperfect fish; S. African Museum.]

— (Cleithrolepis); preoccupied in Hemiptera, 1926 by Mendocinichthys Whitley, 1953

Mendocinia Groeni g. n. n. A. F. Bordas, 1944. Physis 19 p. 458 pl. ii. f. 2. [Trias: Argentina]
1955. M. G. B. Schaeffer Amer. Mus. Nov. 1737 8 figs. = a Perleidid. Mentions M. granulis n. n. 127

1941. Cleithrolepis minor. R. T. Wade, J. Proc. R.S. N.S.W. 75 p. 81 t-f. 7 pl. iii. f. 1.

P. 5455 a. Imperfect head with opercular apparatus, and fragment of trunk with pectoral fin, described and figured *ibid.* p. 141, pl. vi. fig. 7.

Presented by Hugh Exton, Esq., M.D., 1888.

The imperfectly known genus *Dipteronotus* (Egerton, Quart. Journ. Geol. Soc. vol. x. 1854, p. 369) appears to be closely related to *Cleithrolepis*, but is distinguished at least by its much-elongated dorsal fin, which is broken in the type specimen, and was originally described by Egerton as double. A single species, *D. cyphus*, is determined by Egerton (*loc. cit.* p. 369, pl. xi.) from the Keuper of Bromsgrove, Worcestershire, the type and only known specimen being now preserved in the Museum of Practical Geology, London.

Cenogenoidei

Genus **AETHEOLEPIS**, A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N.S. Wales, Palæont. no. 9.]

Trunk deep and laterally compressed. Head small, and external bones more or less tuberculated. Notochord persistent, apparently without ossifications in the sheath. Fin-fulcra well developed. Pectoral fins placed laterally; pelvic fins of moderate size; dorsal and anal fins extended, acuminate in front, and both remotely situated; [? caudal fin not forked]. Scales of abdominal region thick, much deeper than broad on the flank, quadrate in form, deeply overlapping, with large peg-and-socket articulation, and an anterior inner longitudinal keel; the scales of this form gradually passing into those of the caudal region, which are very thin, deeply imbricating, and more or less oval in shape. Scale-ornament consisting of tubercles.

Aetheolepis mirabilis, A. S. Woodward.

1893. *Aetheolepis*, A. S. Woodward, Natural Science, vol. iii. p. 449, woodc. [Described in forthcoming Mem. Geol. Surv. N.S. Wales, Palæont. no. 9.]

Type. Nearly complete fish; Museum of Geol. Surv. N.S. Wales, Sydney.

The type species, attaining a length of about 0·17. Length of trunk from the pectoral arch to the base of the caudal fin equalling scarcely more than three-quarters of the maximum depth; the dorsal margin gibbously curved, the ventral margin more regularly arched. Head with opercular apparatus occupying slightly more than one-quarter of the total length of the fish to the base of the

caudal fin. Pelvic fins arising much nearer to the anal than to the pectorals; the dorsal fin, with about 24 rays, arising considerably in advance of the middle point of the back and extending nearly to the base of the caudal fin; the anal fin, with 17 rays, opposed to the hinder two-thirds of the dorsal, and the length of its foremost ray equalling nearly half of the maximum depth of the trunk. The thickened abdominal squamation terminating abruptly at a line joining the origin of the dorsal and anal fins.

Form. & Loc. Upper Hawkesbury-Wianamatta Series: Talbralgar, New South Wales.

Not represented in the Collection.

Genus **TETRAGONOLEPIS,** Bronn.

[Neues Jahrb. 1830, p. 30.]

Syn. *Pleurolepis*, F. A. Quenstedt, Handb. Petrefakt. 1852, p. 214.
Homœolepis, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. 1860, p. 92.

Trunk much laterally compressed, cycloidal or very deeply fusiform, and the abdominal region relatively large, protuberant ventrally. Head comparatively small, with well-developed opercular bones arranged in an arched series; preoperculum narrow; the external bones in part ornamented with superficial tuberculations of ganoine. Marginal teeth styliform, in close regular series. Notochord persistent, apparently with pleurocentra and hypocentra; ribs short but ossified; neural spines fused with their supporting arches throughout, and both neurals and hæmals in caudal region with laminar expansion on anterior border. Fins consisting of distally bifurcating rays; paired fins small, the pectorals situated at about the middle of the flank, the pelvic fins remote; dorsal fin much elongated, arising about the middle of the back, and anal fin shorter, opposed to the hinder half of the dorsal; caudal fin only slightly, if at all, forked. Scales quadrangular, very deep on the flank, smooth, rugose, or tuberculated, and the anterior border strengthened by a robust inner rib, which forms the peg-and-socket articulation; caudal scales much thinner than those of the abdominal region; ventral ridge-scales conspicuous, serrated.

Tetragonolepis semicincta, Bronn.

[Plate III. fig. 1.]

1830. *Tetragonolepis semicinctus*, H. G. Bronn, Neues Jahrb. p. 30, pl. i. fig. 2.
1832. *Tetragonolepis semicinctus*, L. Agassiz, Neues Jahrb. p. 147.

1924. Pleurolepis ex aff. semicinctus, L. Rüger, Centralb. f. Min. N° 23 Decemb. p. 724.

1952. Tetragonolepis semicinctus B. Hauff, das Unterdevon [illegible] p. 24 pl. 50.

1835. *Tetragonolepis semicinctus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 196, pl. xxii. figs. 2, 3.
1842. *Tetragonolepis subserratus*, G. von Münster, Neues Jahrb. p. 97. [Imperfect fish; Palæontological Museum, Munich.]
1843. *Tetragonolepis semicinctus*, F. A. Quenstedt, Flözgeb. Württemb. p. 240.
1852. *Pleurolepis semicinctus*, F. A. Quenstedt, Handb. Petrefakt. p. 214.
1853. *Tetragonolepis subserratus* = *T. semicinctus* (?), Sir P. Egerton, Quart. Journ. Geol. Soc. vol. ix. p. 277, pl. xi. fig. 3.
1853. *Tetragonolepis cyclosoma*, Sir P. Egerton, *ibid.* p. 278. [Imperfect fish; British Museum.]
1858. *Tetragonolepis semicinctus*, F. A. Quenstedt, Der Jura, p. 229, pl. xxix. fig. 5.
1860. *Pleurolepis semicincta*, A. Wagner, Gelehrte Anzeig. k. bay Akad. Wiss. vol. l. p. 94.
1883. *Pleurolepis semicinctus*, F. A. Quenstedt, Handb. Petrefakt. ed. 3, p. 323.
1892. *Tetragonolepis semicinctus*, O. M. Reis, Geogn. Jahresh. 1891, p. 160, fig. 11.

Type. Fish, imperfect anteriorly.

The type species, attaining a length of about 0·1. The maximum depth of the trunk five times as great as the depth of the caudal pedicle, and contained one-and-a-half times in the total length of the fish; the greatest depth of that portion of the trunk below the vertebral axis equalling about three times that of the portion above the axis. Head with opercular apparatus occupying nearly one-quarter of the total length; external bones feebly tuberculated; marginal teeth slender. Scales smooth, or with slight rugæ following the concentric lines of growth, the hinder border serrated; those of the flanks very deep, and the ventral ridge-scales finely denticulated.

The best figure of this species hitherto published is given by Quenstedt, Der Jura, pl. xxix. fig. 5.

Form. & Loc. Upper Lias: Würtemberg and Bavaria. ? Baden ?

16369. Imperfect head and trunk with remains of the paired fins; Ohmden, near Boll, Würtemberg. The squamation is almost entirely removed in the caudal region, and some of the laminar appendages of the neural spines are shown.
Purchased, 1842.

22524. Similar specimen wanting all the fins, but displaying some of the teeth; Boll. Appearances in the axial skeleton of the trunk suggest either that the neural and hæmal

arches were much expanded or that small ossifications were developed in the notochordal sheath.

Purchased, 1848.

19663–64. A large distorted fish imperfect dorsally, in counterpart Boll. Part of the abdominal squamation is displayed.

Purchased, 1845.

P. 1595, P. 3625 a. Imperfect head and the lower portion of the abdominal region, in counterpart; Boll.

Egerton & Enniskillen Colls.

P. 3625 b, c. Two typical specimens showing the feeble character of the squamation in the caudal region; Boll. The first specimen displays the median fins, and is shown of the natural size in Pl. III. fig. 1. *Enniskillen Coll.*

22531. A small fish 0·065 in length, with remains of all the fins; Boll. Like No. 22524, this specimen also appears to exhibit pleurocentra and hypocentra in the caudal region.

Purchased, 1848.

P. 1596. Small specimen about 0·05 in length, labelled *T. subserratus* by Egerton; Banz, Bavaria. *Egerton Coll.*

P. 1593, P. 3626. Two very imperfect small specimens, the second wanting the caudal region and the first wanting also the head, labelled *T. cyclosoma* in Egerton's handwriting and evidently to be regarded as the types of that species; from Banz and Ohmden respectively.

Egerton & Enniskillen Colls.

Tetragonolepis discus, Egerton.

1853. *Tetragonolepis discus,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. ix. p. 278, pl. xi. fig. 5.

1860. *Pleurolepis discus,* A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. p. 96.

Type. Head and trunk; collection of Rev. P. B. Brodie.

A smaller species than the type, nearly similar in proportions, but with a less protuberant abdominal region; the greatest depth of that portion of the trunk below the vertebral axis less than three times as great as that of the portion above the axis. Scales smooth, or with slight rugæ following the concentric lines of growth, the hinder border not serrated; those of the abdominal flank relatively broad; ventral ridge-scales very finely serrated.

Form. & Loc. Upper Lias: Gloucestershire.

P. 1594. A small fish wanting the caudal region, showing the position of the pelvic fins; Dumbleton. *Egerton Coll.*

P. 3624. Two specimens of the abdominal region, one also exhibiting the opercular apparatus and pectoral fin; Dumbleton. *Enniskillen Coll.*

P. 7039. Fragment of abdominal squamation; Dumbleton. *Purchased*, 1894.

Tetragonolepis oldhami, Egerton.

1878. *Tetragonolepis oldhami,* Sir P. Egerton, Palæont. Indica, [4] vol. i. pt. ii. p. 3, pl. ii. fig. 1.

Type. Fish wanting head and caudal region; Indian Museum. Calcutta.

A species attaining a length of about 0·15, with trunk apparently less deepened than in the type; the greatest depth of that portion of the trunk below the vertebral axis equalling about twice that of the portion above the axis. Cranial roof closely tuberculated, facial and opercular bones apparently smooth. Ventral ridge-scales tuberculated and sharply serrated.

Form. & Loc. Lower Jurassic (Kota Group): Deccan, India.

Not represented in the Collection.

Tetragonolepis drosera, Egerton.

1852. *Pleurolepis*, sp., F. A. Quenstedt, Handb. Petrefakt. p. 215.

1853. *Tetragonolepis droserus,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. ix. p. 278, pl. xi. fig. 4.

1858. *Tetragonolepis cinctus,* F. A. Quenstedt, Der Jura, p. 230, pl. xxix. figs. 6, 7. [Nearly complete fish; Tübingen University Museum.]

1860. *Homœolepis drosera,* A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 97.

Type. Imperfect fish; British Museum.

A large species, attaining a length of about 0·3, and somewhat more elongated than the type. Head with opercular apparatus occupying about one-quarter of the total length; the external bones closely granulated. Scales ornamented with numerous granulations, rarely fused into short rugæ; the hinder border not serrated.

This species is regarded by Wagner as the type of a distinct genus, *Homœolepis*, said to be separated from *Tetragonolepis* by the much less protuberant character of the ventral region, the relatively

lower position of the pectoral fin, and by the greater number of scales in the vertical series below the vertebral axis. A somewhat deeper form than the typical fish is also named by Wagner, var. *orbiculata*.

Form. & Loc. Upper Lias: Würtemberg.

20563. The type specimen described by Egerton, *loc. cit.*; Boll. *Purchased.*

Fragmentary specimens have also been described under the following names, but there are no examples of these species in the Collection :—

Tetragonolepis analis, Sir P. Egerton, Palæont. Indica, [4] vol. i. pt. ii. (1878), p. 5, pl. iii. fig. 1.—Lower Jurassic (Kota Group); Deccan, India. [Ventral part of trunk; Indian Museum, Calcutta.] (? *Cleithrolepis.*)

Tetragonolepis rugosus, Sir P. Egerton, *ibid.* p. 6, pl. ii. fig. 2.—Ibid. [Portion of squamation; Indian Museum, Calcutta.]

Tetragonolepis minor: Homœolepis minor, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. 1860, p. 100.—Upper Lias; Boll, Würtemberg. [Nearly complete fish; Palæontological Museum, Munich.]

Indeterminable fragments, probably not of this genus, have also been named as follows :—

Tetragonolepis dubius, G. von Münster, Beitr. Petrefakt. pt. iv. (1841), p. 140.—Muschelkalk; Esperstädt, Thuringia. [Scale.]

Tetragonolepis ? obscurus, G. von Münster, *ibid.* p. 140, pl. xvi. fig. 18.—St. Cassian Beds; Tyrol. [Tuberculated bone.]

Tetragonolepis quadratus, T. C. Winkler, Archiv. Mus. Teyler, vol. v. (1880), p. 136, pl. viii. fig. 35.—Muschelkalk; Hochberg, Würzburg. [Scale.]

An indeterminable specimen from a so-called Jurassic horizon at Bogoslowsk, Siberia, is described by G. Fischer de Waldheim under the new generic and specific name of *Prionopleurus bronni* (Bull. Soc. Imp. Nat. Moscou, vol. xxv. 1852, pt. i. p. 171, pl. iii. figs. 4–6). The description is unsatisfactory, and whether or not the fossil is related to *Tetragonolepis* remains to be determined.

renamed Pantelaion G. P. Whitley 1951
P.R.Z.S., N.S.W 1949-50 p. 68

Aphalolepis delphi g. n. s. n. F. Heller 1953, Geol. Bl. Nordost-Bayern 3, 3, p. 81 pl. vi Imp. fiss. Thias. Franconia

Promecosomina baeomensis, g. n. s. n. M. Trias. N.S.W.

Homoeolepis subobiculata Eastm. see p. 154.

Tetragonolepis serratus, J. Henry, Mém. Soc. d'Émulat. Doubs [4] vol. x (1876), p. 417, pl. ii. fig. 24.— Rhaetic; [Scale only.]

Angolaichthys lenkei g. n. s. n. Karoo; Angola, C. Teixeira 1947 Bolleria, 16 (43) p. 57.; 1948, Bol. Soc. geol. Portugal, 7 pp. 77-82, 3 pls.; 1958, Bol. Soc. geol. Portugal 12.3 1958, 83-92 2 pls.; 1961, Garcia de Orta 9.2 309 1960. Publ. cult. Cia Diamant Angola 50 88 pls. ix + xii.

Cyamodus? regenys bowralensis g. n. s. n. R. T. Wade 1962. J. Proc. R.S. N.S.W. 95 p. 145 1 fig., pl. xiii. fig. B.

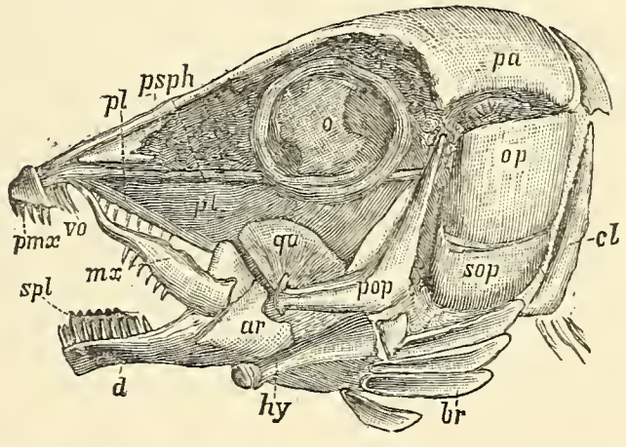
Sogenannt "Lepidosteid" from M. Muschelkalk of N. Baden, L. Rüger, 1924 Jahresb. oberrh. Geol. Ver xiii p. 112 fig.

Family MACROSEMIIDÆ.

Trunk elongate or elongate-fusiform, more or less laterally compressed. Cranial and facial bones moderately robust or delicate, and opercular apparatus complete; mandibular suspensorium vertical or inclined forwards, and gape of mouth small; marginal teeth styliform, inner teeth similar or tubercular. Notochord persistent, the vertebræ never advancing beyond the annular stage. Fin-rays robust, the majority well-spaced, articulated and divided distally; fulcra variable; dorsal fin elongated, usually extending at least half the length of the trunk. Scales rhombic.

The cranial osteology of the Macrosemiidæ is as yet very unsatisfactorily known, the only illustration of importance hitherto published being that of the skull of *Macrosemius* by K. A. von Zittel, reproduced below (fig. 29). The basicranial axis is always straight and nearly parallel with the hinder portion of the cranial roof; there is no interorbital septum; the cleft of the mouth is horizontal, and the rostrum does not project beyond the mandible.

Fig. 29.



Macrosemius latiusculus; head and opercular apparatus, left lateral aspect (after Zittel).

ar., angular; *br.*, branchiostegal rays; *cl.*, clavicle; *d.*, dentary; *hy.*, ceratohyal; *mx.*, maxilla; *o.*, orbit; *op.*, operculum; *p.op.*, preoperculum; *pa.*, parietal region; *pl.*, pterygo-palatine arcade; *pmx.*, premaxilla; *psph.*, parasphenoid; *qu.*, quadrate; *s.op.*, suboperculum; *spl.*, splenial; *vo.*, vomer.

In *Macrosemius* the sclerotic of the eye is ossified, and the cheek-plates seem to have been very delicate. The mandibular suspensorium is inclined so much forwards that the articulation of the quadrate (*qu.*) is beneath the front margin of the orbit (*o.*). The

pterygo-palatine arcade (*pl.*) bears at least one series of large, well-spaced conical or styliform teeth; and there is a cluster of similar teeth on the vomer (*vo.*). The maxilla (*mx.*) is elongated, tapering in front; and the premaxilla (*pmx.*) is very short, with a slender ascending process. The mandible is much deepened in the coronoid region, and von Zittel recognizes dentary (*d.*), splenial (*spl.*), and angular (*ar.*) elements. In the hyoid arch, the epihyal, ceratohyal, and hypohyal bones are well ossified. The opercular apparatus is complete; the suboperculum (*s.op.*) exhibiting an ascending process at its antero-superior angle, and the large inferior limb of the preoperculum (*p.op.*) being much turned forwards. The branchiostegal rays (*br.*) are few, well-spaced, constricted at their point of attachment and much expanded in their distal portion. A gular plate has only been observed in *Ophiopsis* and *Eusemius*.

The ossifications in the notochordal sheath do not advance beyond the stage of unconstricted rings; and Vetter [1] has observed completed annular pleurocentra and hypocentra alternating in the caudal region of *Ophiopsis*. The ribs are ossified, though usually delicate and not extending quite to the ventral border of the fish; and the neural spines are fused with their supporting arches both in the abdominal and caudal regions.

The basals in the pectoral fin of *Ophiopsis* are not less than nine in number (Pl. III. fig. 3); and the pelvic fin-supports are irregularly hour-glass shaped, the proximal end exhibiting the widest expansion.

There is one series of enlarged postclavicular scales, especially well shown in *Histionotus*; and the dorsal fin-rays in this genus seem to be equal in number to the vertical series of regular flank-scales beneath them [2]. There are enlarged ridge-scales on the caudal pedicle, which attain an extreme development on its ventral border in *Macrosemius*.

Synopsis of Genera.

I. Dorsal fin single.

Back nearly straight and dorsal fin occupying from one-half to two-thirds of its length; caudal fin forked; fulcra on all median fins; squamation complete and flank-scales scarcely if at all deepened.. *Ophiopsis* (p. 165).

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[1] Mitth. k. mineral.-geol. Mus. Dresden, pt. iv. (1881), p. 56.

[2] See figure of *Histionotus angularis* by J. C. Mansel-Pleydell, Geol. Mag. [3] vol. vi. (1889), pl. vii.

Back elevated and angulated anteriorly, the dorsal fin extending from the angulation almost to the caudal fin, which is deeply forked; uniserial fulcra on both paired and median fins; squamation complete and flank-scales deepened .. *Histionotus* (p. 173).

Back nearly straight, and dorsal fin extending almost its whole length; squamation apparently complete, the flank-scales very large and much deepened.. *Legnonotus* (p. 176).

Back nearly straight, and dorsal fin extending almost its whole length; caudal fin not forked, rounded; fulcra only on the caudal fin; scales thin, wanting dorsally and ventrally, those of the flank scarcely deepened and the vertical series dichotomous above; much-enlarged ridge-scales on lower border of caudal pedicle. *Macrosemius* (p. 176).

Back nearly straight, and dorsal fin extending almost its whole length; (?) no anal fin; squamation robust and complete, but irregular, the flank-scales not much if at all deepened, the vertical series apparently sometimes dichotomous dorsally and ventrally ..... *Petalopteryx* (p. 181).

II. Dorsal fin subdivided into two parts.

Vertebral rings feeble or absent; anterior portion of dorsal deeper than the posterior portion; squamation complete .. *Propterus* (p. 183).

Vertebral rings robust; anterior portion of dorsal with comparatively widely spaced rays, not deeper than the posterior portion; squamation complete ..... *Notagogus* (p. 186).

Genus **OPHIOPSIS,** Agassiz.

[Neues Jahrb. 1834, p. 385.]

Trunk much elongated, gradually tapering from the occiput backwards or the dorsal margin only slightly arcuate; head large or of moderate size. Marginal teeth acutely pointed. Notochord invested with delicate ring-vertebræ; ribs ossified. Bifurcation of dorsal fin-rays variable; fulcra often absent on paired fins and usually confined to the base of the median fins. Paired fins relatively large; dorsal fin ordinarily extending about half the length of the back, high in front, low behind; anal fin small; caudal fin forked. Scales covering the whole of the trunk, in regular series, united by

peg-and-socket articulation, and often pectinated at the hinder border; the scales of the middle of the flank scarcely deeper than broad, few of the ventral scales much broader than deep; no enlarged ridge-scales.

This is the least specialised genus ascribed to the Macrosemiidæ, and may be regarded as a link between this family and that of the Eugnathidæ.

Ophiopsis procera, Agassiz.

1844. *Ophiopsis procerus,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 289, pl. xlviii. fig. 1.
1851. *Ophiopsis procerus,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 60.
1863. *Ophiopsis procera,* A. Wagner, *ibid.* vol. ix. p. 653.

Type. Imperfectly preserved fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·3. Length of head with opercular apparatus equalling the maximum depth of the trunk, and occupying about one-fifth of the total length of the fish; maximum depth of trunk twice as great as the width of the caudal pedicle. External ornament of head and opercular bones consisting of small, sparse tuberculations; teeth small. Dorsal fin occupying nearly half the length of the back, and comprising about 25 distally-bifurcated rays, of which the anterior are much elongated, while the others rapidly become much shortened; pelvic fins arising slightly in advance of the middle point between the pectorals and the caudal. Scales large and smooth, with delicately pectinated hinder border except towards the end of the caudal region.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37029. Full-sized specimen with imperfect head and fins, in counterpart; Solenhofen. The tuberculation of the head and opercular bones and post clavicular plates is distinct; and the closely arranged, slightly constricted, smooth ring-vertebræ are well shown. The greater part of the squamation is also displayed. *Häberlein Coll.*

P. 6939. Another fine specimen 0·25 in length, displaying all the fins except the anal, and with well-preserved squamation; Eichstädt. *By exchange,* 1893.

Stensiö, Rayner 1941 Biol. Rev. 16 p. 225 ff. 5A.

1914. *Ophiopsis procera*, C. R. Eastman, Mem. Carnegie Inst. vol. vi. p. 404, pl. 7xx. fig. 1.

1918. *Ophiopsis procera*. A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 71, text-fig. 25.

P.6939. Basis of restoration, A.S.W. 1918.

1905. Oph. attenuata, K. G. Krambergen, Beitr. Pal. Öst.-Ungarns, p. 218, pl. xx(iv) f. 3-4. U. Trias: Hallein NOT.

O. a. but n. sp. hegnotholus (L. krambergeri R.S.W. MS. P. 10286-Y).

1914. Ophiopsis attenuata, C. R. Eastman, Mem. Carnegie Mus. vol. VI, p. 405, pl. Txii. fig. 1.

1949. O. a., P. de Saint-Seine, N. Arch. Mus. N.H. Lyon 2 p. 183 A. 80 pl. xix f. c.

Ophiopsis attenuata, Wagner.

[Plate III. figs. 2, 3.]

1863. *Ophiopsis attenuata,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 655.

1873. *Ophiopsis attenuata,* V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 19, pl. viii. fig. 2.

Type. Trunk of fish; Palæontological Museum, Munich.

Form and proportions as in the type species, but the fish not attaining so large a size. External head-bones and opercular bones smooth; dorsal fin-rays mostly, if not all, undivided; scales delicately serrated, not pectinated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria, and Ain, France.

P. 1093. Fish of the form ascribed to this species by Thiollière; Cirin, Ain, France. The head is shown only in impression, and the dorsal fin is very imperfect. *Egerton Coll.*

P. 3609. Small individual 0·075 in length, wanting the anal fin shown of the natural size in Pl. III. fig. 2; Kelheim, Bavaria. The opercular elements and the fins are especially well exhibited, but no fulcra are preserved except at the base of the caudal fin. *Enniskillen Coll.*

P. 1090. More imperfect example of a similar fish, displaying the paired fins; Kelheim. The outer aspect of the left pectoral fin is represented of three times the natural size in Pl. III. fig. 3. Several elongated basal cartilages (*b*) are indicated, the hindermost one being much larger than the others, with its upper extremity more inclined forwards. Above the basal lobe is an enlarged scale (*x*), apparently of the postclavicular series; and the fin-rays are about 12 or 13 in number. *Egerton Coll.*

Ophiopsis æqualis, Wagner.

1863. *Ophiopsis æqualis,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 656.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species attaining a length of about 0·2. Length of head with opercular apparatus exceeding the maximum depth of the trunk and contained about four-and-a-half times in the total length of the sh; maximum depth of trunk twice as great as the width of the

caudal pedicle. Dorsal fin extending about half the length of the back; pelvic fins arising much nearer to the pectorals than to the caudal. Scales of moderate size, smooth and delicately serrated.

A fish from the Lithographic Stone, described as intermediate between this species and *O. attenuata*, is named *O. intermedia* by Wagner, *loc. cit.* p. 657. The type specimen is a well-preserved fish in the Palæontological Museum, Munich.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 7176. Fish 0·135 in length, much crushed, the dorsal fin and squamation shown only in impression; Eichstädt. Granular teeth are exhibited apparently on the splenial and pterygoid bones; and about 12 branchiostegal rays are shown in series. The length of the pectoral fin-rays appears to be nearly equal to the depth of the back of the head. *Purchased*, 1894.

Ophiopsis tenuiserrata (Agassiz).

1844. *Pholidophorus tenuiserratus*, L. Agassiz (*ex* Münster, MS.), Poiss. Foss. vol. ii. pt. i. p. 276, pl. xxxviii. fig. 3, pl. xlii. fig. 4.

1851. *Ophiopsis serratus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 62. [Imperfect fish; Palæontological Museum, Munich.]

1863. *Ophiopsis serrata*, A. Wagner, *ibid.* vol. ix. p. 654.

1881. *Ophiopsis serrata*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 55.

Type. Imperfect fish; Woodwardian Museum, Cambridge.

A robust species, attaining a length of 0·18. Head with opercular apparatus occupying nearly one-fifth of the total length; maximum depth of trunk twice as great as the width of the caudal pedicle and contained five times in the total length of the fish. Fin-fulcra very slender, present on paired fins. Dorsal fin occupying slightly less than half of the back and comprising 25 rays, mostly bifurcated, of which the anterior three are extremely elongated (their length exceeding the depth of the trunk) and the others rapidly become much shortened posteriorly; pelvic fins arising considerably in advance of the middle point between the pectorals and caudal. Scales smooth, those of the flank finely serrated and partly pectinated at the hinder margin, except towards the extremity of the caudal region.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

1906. *Ophiopsis tenuiserrata*, E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 185.

1896. Ophiopsis guipardii, H. Sauvin, Archiv f. Naturgesch. vol. i. p. 170, pl. x. f. 6 [structure of scale].

1949. O. g. P. de Saint-Seine N. Arch. Mus. N.H. Lyon 2me p. 187, ff. 81, 82 pl. xix. f A, B.

1918. Ophiopsis penicillata, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 71, pl. xvi. figs. 1, 2.

P. 1077. Nearly complete trunk wanting the head; Kelheim. The dorsal fin is especially well preserved, and the squamation of the left side is shown from the inner aspect.
Egerton Coll.

P. 3599. Imperfect caudal region figured by Agassiz, *loc. cit.* pl. xxxviii. fig. 3; Kelheim. *Enniskillen Coll.*

P. 3602. Small specimen wanting extremity of head and tail; Kelheim. *Enniskillen Coll.*

Ophiopsis guigardi, Thiollière.

1873. *Ophiopsis guigardi,* V. Thiollière, Poiss. Foss. Bugey, pt. ii. pl. vii. (fig. only).

Type. Nearly complete fish; Lyons Museum.

A species attaining a length of about 0·3. Length of head with opercular apparatus equal to the maximum depth of the trunk and contained about five-and-a-half times in the total length of the fish; maximum depth of trunk twice as great as the depth of the caudal pedicle. Fin-fulcra slender, extending up the anterior ray of each median fin. Dorsal fin less than half as long as the back, much elevated in front, arising at the beginning of the second third of the trunk. Scales relatively large and smooth.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Cirin, Ain, France.

Not represented in the Collection.

Ophiopsis penicillata, Agassiz.

1844. *Ophiopsis penicillatus,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 290, pl. xxxvi. figs. 2–4.

Type. Nearly complete fish; British Museum.

A robust species of moderate size. Head with opercular apparatus occupying slightly less than one-quarter of the total length; maximum depth of trunk twice as great as the width of the caudal pedicle and contained five times in the total length. External head-bones conspicuously tuberculated; teeth long and slender. Dorsal fin arising at the end of the anterior third of the back, half as long as the trunk, comprising not less than 25 rays, mostly bifurcated, of which the longest do not equal the depth of the trunk at their point of insertion; pelvic fins arising slightly in advance of the middle point between the pectorals and the caudal.

The scales of this species are described by Agassiz as smooth and

non-denticulated; but in the type and only known specimen none of the scales of the flank are exposed from the outer aspect, their hinder border being thus obscured.

Form. & Loc. Purbeck Beds: (?) Dorsetshire.

P. 7433. Type specimen; probably from the neighbourhood of Swanage. *Old Collection.*

Ophiopsis breviceps, Egerton.

1852. *Ophiopsis breviceps,* Sir P. Egerton, Figs. & Descript. Brit. Organic Remains (Mem. Geol. Surv.), dec. vi. no. 6, pl. vi.

Type. Nearly complete fish; Museum of Practical Geology.

A robust species of small size, attaining a length of about 0·12. Head with opercular apparatus occupying slightly less than one-quarter of the total length; maximum depth of trunk twice as great as the width of the caudal pedicle and contained nearly four-and-a-half times in the total length. Head and opercular bones coarsely ornamented with tubercles and rugæ; teeth elongate-conical. Dorsal fin comprising not less than 35 rays and occupying the greater part of the hinder two-thirds of the trunk, not so deep as the trunk at its point of origin; pelvic fins arising almost at the middle point between the pectorals and the caudal. Scales smooth and somewhat concave externally, with a coarsely serrated hinder border.

Form. & Loc. Purbeck Beds: Wiltshire.

P. 3608. A typical specimen with scattered squamation and head-bones, and the fins only shown in impression; Wockley. near Tisbury. The premaxillæ exhibit an upwardly-ascending extension, and the outer aspect of an operculum shows the coarsely rugose character of the surface-ornament. The vertebræ, as usual, are very delicate. *Enniskillen Coll.*

46410. Imperfect hinder two-thirds of the trunk, with remains of dorsal fin; near Tisbury. *Cunnington Coll.*

P. 583. Fragmentary specimen labelled by Egerton as the counterpart of the original of his fig. 2, *loc. cit.*; Wockley, near Tisbury. *Egerton Coll.*

P. 1094. Two specimens exhibiting vertebræ, scales, and other fragments; Wockley. *Egerton Coll.*

P.7433. Des.? & fig.! A.S.W. 1918, p. 72, pl. xvi. fig. 1.

P.8375. Imperfect fish, in counterpart, bases of dorsal fin-rays des.? & fig.? A.S.W. 1918, p. 73, pl. xvi. fig. 2; Purbeckian, Portland. Bye exchange.

1918. Asthiopsis brevicaps, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 73, pl. xvi. figs. 3–12.

P.3608. Portion of operculum des.? & fig.? A.S.W. 1918, p. 74, pl. xvi. fig. 7.

P.9107, a–c. Four imperfect fishes; Tisbury. Roof of skull of P.9107 a des.? & fig.? A.S.W. 1918, p. 74, pl. xvi. fig. 4. Scales of P.9107 b, c, des.? & fig.? ibid. p. 75, pl. xvi. figs. 9, 10, 12. Purchased, 1899.

P.9436. Two imperfect specimens; Workley, Tisbury. Pmx., md., scl., & scale des.? & fig.? A.S.W. 1918, pp. 74, 75, pl. xvi. figs. 5, 6, 8, 11. Pres.? by Dr. A. K. Coomaraswamy, 1901.

1918. *Ophiopsis dorsalis*, A. S. Woodward, Fossil Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 75, pl. xvi. fig. 13.

P. 466. Des.? & fig.? A. S. W. 1918, p. 76, pl. xvi. fig. 13.

Ophiopsis dorsalis, Agassiz.

1844. *Ophiopsis dorsalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 291, pl. xxxvi. fig. 5.

Type. Nearly complete fish; British Museum.

A much elongated species, attaining a length of 0·16. Head with opercular apparatus occupying one-fifth of the total length; maximum depth of trunk twice as great as the width of the caudal pedicle, and contained somewhat more than six times in the total length. Head and opercular bones externally rugose. Dorsal fin comprising not less than 35 rays and occupying the greater part of the back, not so deep as the trunk at its point of origin; pelvic fins arising slightly in advance of the middle point between the pectorals and caudal. Scales smooth and somewhat concave externally, those of the flank finely serrated on the hinder border, those of the caudal region often irregularly punctated.

Form. & Loc. Purbeck Beds: Dorsetshire.

P. 466. Type specimen; probably from Swanage, erroneously described by Agassiz as from the Lower Oolite of Northampton. *Egerton Coll.*

P. 7496. A more imperfectly preserved specimen, in counterpart; Swanage. *Purchased.*

Ophiopsis flesheri (Agassiz).

1844. *Pholidophorus flesherii*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 281, pl. xxxvii. fig. 8.

1887. *Ophiopsis flesheri*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 217.

Type. Nearly complete fish; imperfect counterpart in British Museum. Bournemouth N. H. Soc. Museum.

A much elongated species, attaining a length of 0·2. Head with opercular apparatus occupying one-fifth of the total length; maximum depth of trunk twice as great as the width of the caudal pedicle, and contained seven times in the total length. Dorsal fin occupying about half the length of the back, and apparently much elevated in front; pelvic fins arising slightly in advance of the middle point between the pectorals and caudal. [Scales apparently serrated.]

Form. & Loc. Inferior Oolite: Northamptonshire.

47138. Portion of counterpart of the type specimen, extending from the back of the head to the middle of the caudal region; from the railway-tunnel near Blisworth. The

squamation being exhibited almost entirely in impression, it is difficult to determine with certainty whether or not the scales are serrated. *Sharp Coll.*

Ophiopsis lepturus (Bellotti).

1857. *Pholidophorus lepturus*, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia, p. 429.

1889. *Ophiopsis lepturus*, W. Deecke, Palæontogr. vol. xxxv. p. 122, pl. vi. fig. 4.

Type. Nearly complete fish.

A small species, about 0·08 in length, differing from the typical forms in the prominence of the upper caudal lobe and the absence of vertebral rings. Length of head with opercular apparatus exceeding the maximum depth of the trunk and contained about four times in the total length of the fish; maximum depth of trunk twice as great as the width of the caudal pedicle. Dorsal fin fringed with conspicuous fulcra, comprising 15 rays, arising immediately behind the anterior third of the trunk and occupying about half of the back. Scales relatively small, in from 42 to 44 vertical series.

Specimens from the Senckenberg Museum, Frankfurt, are described by Deecke.

Form. & Loc. Muschelkalk: Perledo, Como, Italy.

Not represented in the Collection.

The following species are imperfectly known and not represented in the Collection:—

Ophiopsis altivelis, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 657.—Lower Kimmeridgian (Lithographic Stone); Kelheim, Bavaria. [Hinder portion of fish; Palæontological Museum, Munich.]

Ophiopsis bellottii, W. Deecke, Palæontogr. vol. xxxv. (1889), p. 124: *Nothosomus bellottii*, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. (1886), p. 37.—Keuper; Besano, Lombardy [Nearly complete fish; Milan Museum.]

Ophiopsis macrodus, V. Thiollière, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. (1850), p. 148, and Poiss. Foss. Bugey, pt. ii. (1873), p. 19.—Lower Kimmeridgian (Lithographic Stone); Cirin, Ain, France. [Nearly complete fish; Lyons Museum.]

A unique specimen from the Lithographic Stone of Eichstädt, Bavaria, now in the Dresden Museum, differs only from the typical

1910. Ophiopsis lepturus, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 87, pl. iii. fig. 4.

Oph. Lepersonni sp. n. P. de Saint-Dacio Ann. Mus. Congo belge (8) Sér. Zoo. S, 1955, p. 14 text figs 3, 4, pl. 1. f. F. ? Tanganyika Congo. [Zaire].

Ophiopsis lariensis, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 89, pl. iii. figs. 5, 6 (includes Pholidoph. rüppelli in part). — R. Sieber 1955, Carinthia II, vol. 65 p. 91 1 fig. M. Tilias: Carinthia.

1 G. De Alessandri, loc. cit. 1910, p. 91, pl. iii. fig. 7.

O. macrodus, C. R. Eastman, Mem. Carnegie Inst. vol. vi (1914), p. 363, pl. 71. fig. 2. P. de Saint-Dacio 1949. N. Arch. Mus. N. H. Lyon 2 p. 191, ff. 83 pl. xx. f. A.

T. of Macrepistius in Amer Mus. Nat. Hist.
An Eugnathid, R. Schaeffer. 1960 Amer. M
Novit. 2011, 18 pp. 8 figs.

Ophiopsis (according to the description) in the non-bifurcated character of all the dorsal fin-rays. It is the type of the genus and species *Eusemius beatæ*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. (1881), p. 51, pl. i. fig. 3. The length of the head with opercular apparatus considerably exceeds the maximum depth of the trunk and is contained little more than three-and-a-half times in the total length of the fish. The dorsal fin comprises about 32 rays; and 11 free supports are described in advance of this. The principal flank-scales are delicately sculptured, exhibit from 4 to 6 strong denticulations on the posterior margin, and are deeper than broad; there are about 44 dorso-ventral series.

The published notices of *Ophiopsis muensteri* (G. von Münster, Neues Jahrb. 1834, p. 385; L. Agassiz, Poiss. Foss. vol. ii. 1844, pt. i. p. 292, pt. ii. p. 289; A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. 1851, p. 60) leave the systematic position of this species doubtful. According to Wagner's description, the vertebral centra are well ossified; according to a figure by von Zittel, who names the species *Isopholis muensteri* (Handb. Palæont. vol. iii. 1887, p. 216, fig. 230), the head is indistinguishable from that of *Eugnathus*. The type specimen, obtained from the Lithographic Stone of Kelheim, Bavaria, is an elongated fish wanting the pelvic, dorsal, and anal fins; it is preserved in the Palæontological Museum, Munich.

The genus *Macrepistius* (E. D. Cope, Journ. Acad. Nat. Sci. Philad. [2] vol. ix. 1894, p. 441), so far as known, appears to differ from *Ophiopsis* only in having all the teeth tumid at the apex, except those of the premaxillæ and the opposing portion of the dentaries. The type species is *M. arenatus* (E. D. Cope, *ibid.* p. 441, pl. xix. fig. 2) from the Neocomian of Glen Rose, Texas, probably attaining a length of about 0·3. The head and opercular bones are ornamented with tubercles, which become confluent on the hinder part of the parietals. The operculum is twice as deep as broad and three times as large as the suboperculum. The dorsal fin originally comprised not less than 32 rays. The scales are irregularly pitted, but not serrated on the hinder margin.

Genus **HISTIONOTUS**, Egerton.

[Ann. Mag. Nat. Hist. [2] vol. xiii. 1854, p. 434.]

Head large, snout acute; the dorsal margin of the trunk rising above the head to an angulation from which the body gradually tapers backwards. Marginal teeth much elongated, closely arranged. Notochord invested with delicate ring-vertebræ. Fins

consisting of distally bifurcating rays, all with large Λ-shaped fulcra; pectoral fins much larger than the pelvic pair; dorsal fin arising at the angulation of the back, extending to the caudal pedicle, high in front, becoming low behind; anal fin small; caudal fin forked. Scales covering the whole of the trunk, in regular series, united by peg-and-socket articulation, and more or less pectinated at the hinder border; the scales of the middle of the flank and of the dorsal region much deeper than broad, with more or less convex hinder border; those of the ventral region at least as broad as deep; postclavicular scales very large; the ridge-scales of the caudal pedicle not much enlarged.

Histionotus angularis, Egerton.

1854–55. *Histionotus angularis,* Sir P. Egerton, Ann. Mag. Nat. Hist. [2] vol. xiii. p. 434, and Figs. & Descript. Brit. Organic Remains (Mem. Geol. Surv.), dec. viii. no. 5, pl. v.

1889. *Histionotus angularis,* J. C. Mansel-Pleydell, Geol. Mag. [3] vol. vi. p. 241, pl. vii.

Type. Fish, wanting tail; British Museum.

The type species, attaining a length of about 0·2. Length of head with opercular apparatus very slightly exceeding its maximum depth, and occupying about one-quarter of the total length of the fish; length of the trunk equalling twice its maximum depth, and the dorsal angulation measuring approximately 148°. The head and opercular bones externally ornamented with fine, closely arranged rugæ; the large postclavicular plates similarly ornamented. Fin-rays stout and smooth; pectoral fins scarcely twice as large as the pelvic pair, and the latter arising in advance of the middle point of the trunk; dorsal fin consisting of at least 25 rays. Pectinations of the scales delicate and confined to their hinder margin, but conspicuous in all regions of the trunk.

Form. & Loc. Purbeck Beds: Dorsetshire and Wiltshire.

P. 577. Type specimen, described and figured by Egerton, *loc. cit.*; Swanage, Dorsetshire. The impression of the caudal region is much less distinct than indicated in the published figure, in which the anal fin is erroneously extended. *Egerton Coll.*

P. 3614. Crushed head and trunk, wanting the greater part of the caudal region; Swanage. *Enniskillen Coll.*

P. 5935. Small fish somewhat distorted and with imperfect fins, but displaying the bifurcation of the caudal; Swanage.

118. *Histionotus angularis*, A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc 1916), p. 77, pl. xvii. figs. 1–5.

P. 577. Des.d & fig.d A. S. W. 1918, p. 77. pl. xvii. fig. 1.

P. 3614. Scales des.d & fig.d A. S. W. 1918, p. 79, pl. xvii. fig. 5. Teeth on maxilla, p. 78. Vertebral rings, p. 78.

P. 5935. Roof of skull des.d & fig.d A. S. W. 1918, p. 77, pl. xvii. fig. 3.

46421. Palatine (or ectopterygoid) des? & fig? A.S.W. 1918, p. 78, pl. xvii. fig. 4.

1914. Histionotus falsani, C.R. Eastman, Mem. Carnegie Inus. vol. vi. p. 364, pl. xlix. fig. 1.
1949. H. f. P. de Saint-Seine N. Arch. Mus. N.H. Lyon 2 p. 208 fig 92.

Probably not of this genus is Histionotus reclinis, C.R. Eastman, Mem. Carnegie Inus. vol. vi (1914), p. 405, pl. lxii. fig. 4. — Litho. Stone; Solenhofen. [Fish; Carnegie Inus.]

Part of the cranial roof is shown, and some of the superior circumorbital bones are preserved.

Purchased, 1889.

P. 3614. Part of a trunk with displaced squamation, showing some ring-vertebræ immediately behind the position of the pelvic fins; Swanage. *Enniskillen Coll.*

46421. Imperfect head and portion of trunk; Tisbury, Wiltshire. *Cunnington Coll.*

Histionotus oberndorferi, Wagner.

1863. *Histionotus oberndorferi,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 650, pl. iii.

1887. *Histionotus oberndorferi,* K. A. von Zittel, Handb. Palæont. vol. iii. p. 218, fig. 231.

Type. Imperfect fish, wanting caudal region; Palæontological Museum, Munich.

An imperfectly known species, differing from *H. angularis* in the more acute angulation of the dorsal margin and in the more coarsely serrated character of the scales.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

49135. Plaster cast of type specimen; Kelheim. *Purchased*, 1878.

Histionotus falsani, Thiollière.

1873. *Histionotus falsani,* V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 14, pl. v. fig. 1.

Type. Much-fractured fish; Lyons Museum.

A species about equalling the type in size, but the maximum depth of the trunk considerably exceeding half its length, and the head with opercular apparatus at least as deep as long.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Cirin, Ain, France.

Not represented in the Collection.

An imperfect small fish in the Dresden Museum, from the Bavarian Lithographic Stone, is also regarded as indicating a distinct species, *Histionotus parvus*, by B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. (1881), p. 48, pl. ii. fig. 5.

Genus **LEGNONOTUS,** Egerton.

[Ann. Mag. Nat. Hist. [2] vol. iii. 1854, p. 435.]

Trunk gradually tapering from the occiput backwards or the dorsal margin only slightly arcuate. Marginal teeth very long and much crowded. Dorsal fin extending almost the whole length of the back, and all the rays, except perhaps anteriorly, distally bifurcating. Scales apparently covering the whole of the trunk, in regular series, those of the middle of the flank much deeper than broad. Lateral line forming a conspicuous ridge.

Legnonotus cothamensis, Egerton.

1854–55. *Legnonotus cothamensis*, Sir P. Egerton, *loc. cit.* p. 435, and Figs. and Descript. Brit. Organic Remains (Mem. Geol. Surv.), dec. viii. no. 7, p. 4, pl. vii. figs. 9–12.

Type. Imperfect trunk; Bristol Museum.

The type species, attaining a length of about 0·06. Marginal teeth bluntly pointed; operculum ornamented with large, flattened tubercles. Dorsal fin comprising about 30 rays. Scales comparatively large, smooth, but coarsely serrated; principal scales of lateral line about two-thirds as broad as deep.

Form. & Loc. Rhætic (Cotham Marble): Aust Cliff, Gloucestershire.

P. 1092. Three small slabs exhibiting portions of jaws associated with a mass of scales, bone-fragments, and ring-vertebræ. *Egerton Coll.*

Genus **MACROSEMIUS,** Agassiz.

[Neues Jahrb. 1834, p. 387.]

Syn. *Disticholepis*, V. Thiollière, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. 1850, p. 136, and Poiss. Foss. Bugey, pt. ii. 1873, p. 14.

Trunk gradually tapering from the occiput backwards; head large, snout acute. Teeth much elongated, closely arranged. Notochord persistent, without ring-vertebræ; ribs ossified. Fins consisting of very robust, bifurcating rays, without fulcra except in the caudal; pectoral fins much larger than the pelvic pair; dorsal fin arising immediately behind the occiput and extending continuously to the caudal pedicle; anal fin small; caudal fin rounded. Scales thin and more or less pectinated, with peg-and-socket articulation, and apparently wanting towards the dorsal margin; scales

Legnonotus Krambergeri, A.S.W.

2 c/o - 167

Form. & Loc. Rhetic: Hallein, Salzburg, Austria.

P.10287. Type specimen. By exchange, 1906.

P.10286. Distorted specimen. By exchange, 1906.

1914. *Macrosemius prostratus*, C.R. Eastman, Mem. Carnegie Inst. vol. vi. p. 406, pl. lxiii. fig. 2.

1949. M. r. Pole Saint-Seine, N. Arch. Mus. N. H. Lyon 2 p. 199 fig. 87. * pl. xxiii f. D.

of the middle of the flank relatively large, becoming smaller both dorsally and ventrally, in the former case by dichotomy of the vertical series; about four very large ridge-scales on the ventral border between the anal and caudal fins.

Macrosemius rostratus, Agassiz.

[Plate III. fig. 4.]

1834. *Macrosemius rostratus*, L. Agassiz, Neues Jahrb. p. 388 (name only).
1844. *Macrosemius rostratus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 150, pl. xlvii. *a*. fig. 1.
1851. *Macrosemius rostratus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 73.
1863. *Macrosemius rostratus*, A. Wagner, *ibid.* vol. ix. p. 647.
1863. *Macrosemius insignis*, A. Wagner, *ibid.* vol. ix. p. 648, pl. ii. [Fish, wanting tail; Palæontological Museum, Munich.]

Type. Nearly complete fish; Royal Bohemian Museum, Prague.

The type species, attaining a length of about 0·3. Head with opercular apparatus somewhat longer than its maximum depth and occupying about one-quarter of the total length of the fish; the maximum depth of the trunk exceeding twice the width of the caudal pedicle. Rays of dorsal fin very long and comparatively slender, without denticles, and about 38–40 in number; the length of those of the hinder portion of the caudal region greater than the depth of that part of the trunk. Pelvic fins arising well in advance of the middle point between the pectoral and caudal fins, and the anal arising shortly behind. Scales conspicuously pectinated.

Closely related to this fish, if not specifically identical, is a trunk from the Lithographic Stone of Kelheim, said to be slightly deeper in proportion to its length but not otherwise distinguished from the typical *M. rostratus*. It is described as the type of *M. latiusculus* by A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. (1851), p. 74; and a head is figured under the same name by K. A. von Zittel, Handb. Palæont. vol. iii. (1887), p. 218, fig. 232 (copied above, fig. 29, p. 163). The original specimens are preserved in the Palæontological Museum, Munich.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37051. Fine specimen 0·275 in length, in counterpart, displaying some of the teeth, a few ribs, the dorsal and caudal fins, and the greater part of the squamation; Solenhofen.

Häberlein Coll.

P. 7177. Another fine specimen 0·165 in length, displaying ribs and all the fins, as shown in Pl. III. fig. 4; Eichstädt. The pelvic fin-supports are seen in impression, much constricted near the distal end, much expanded proximally.
Purchased, 1894.

37094. Distorted fish, imperfectly preserved but showing the pectinated squamation; Solenhofen. *Häberlein Coll.*

P. 956. Imperfect head and abdominal region, showing the paired fins; Kelheim. *Egerton Coll.*

P. 955, P. 3616. Imperfect trunk 0·07 in length, in counterpart, with displaced squamation, showing ossified ribs and dorsal fin-supports with expanded distal ends; Kelheim. The scales are finely serrated.
Egerton and Enniskillen Colls.

Dysticholepis

Macrosemius dumortieri (Thiollière).

1858. *Disticholepis dumortieri*, V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. p. 783 (name only).
1873. *Disticholepis dumortieri*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 15, pl. vi. fig. 1.
1883. *Disticholepis dumortieri*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. xi. p. 479.

Type. Nearly complete fish; Lyons Museum.

A species of moderate size. Head with opercular apparatus somewhat longer than its maximum depth, and occupying about one-quarter of the total length of the fish; the maximum depth of the trunk nearly three times as great as the width of the caudal pedicle. Rays of dorsal fin about 32 in number, denticulated on their posterior border and stout but not expanded; the length of those of the caudal region scarcely if at all exceeding the depth of that part of the trunk. Pelvic fins arising slightly in advance of the middle point between the pectoral and caudal fins, and the anal arising shortly behind. Scales conspicuously pectinated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 4684. Imperfect impression of a typical fish; Cirin.
Purchased, 1884.

Disticholepis

Macrosemius fourneti (Thiollière).

1850. *Disticholepis fourneti*, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 136.

Districholepis

See S. Soc. E. 1849 p. 200.

1949. D. d. P. de Saint-Seine N. Arch. Mus H.N. Lyon 2 p. 204 pl. xxi f. B.

1849. D. f. P. de St Seine N. Arch. Mus. H.N. Lyon 2
p. 201. pl. 88-9, pl. XVI f. A.

Enchelyolepis, A.S.W.

[Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 80.]

1918. Enchelyolepis pectoralis, A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 81, pl. xvii. fig. 7.

1854. *Disticholepis fourneti*, V. Thiollière, Poiss. Foss. Bugey, pt. i. pl. viii.

1873. *Disticholepis fourneti*, V. Thiollière, *ibid.* pt. ii. p. 15.

Type. Nearly complete fish; Lyons Museum.

A large species attaining a length of about 0·3. Head with opercular apparatus longer than its maximum depth, and occupying about one-quarter of the total length of the fish; maximum depth of the trunk scarcely more than twice as great as the width of the caudal pedicle. Rays of dorsal fin about 34 in number, very stout, and denticulated on their posterior border; those of the hinder half of the fin somewhat expanded distally, and their length not exceeding the depth of the caudal region of the trunk. Pelvic fins arising almost midway between the pectoral and caudal fins, and the anal arising shortly behind. Scales usually covered with fine striæ extending from the delicate pectinations of the hinder border.

This is the type species of the so-called *Disticholepis*, which is regarded by Wagner (Gelehrte Anzeig. k. bay. Akad. Wiss. 1860, p. 402) as doubtfully distinct from *Macrosemius*.

It is not improbable that the fish from Cirin, erroneously ascribed by Thiollière (*op. cit.* pt. ii. p. 14, pl. v. fig. 2) to *Macrosemius rostratus*, is a small example of this species.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 4685. The greater portion of the trunk, with the dorsal and caudal fins, of a large individual chiefly shown in impression; Cirin. *Purchased*, 1884.

P. 4685 a. Imperfect impression of a fish 0·2 in length, showing all the fins; Cirin. *Purchased*, 1884.

P. 1091. Hinder abdominal and caudal regions of a small individual, much fractured; Cirin. Distinct denticles of ganoine are seen upon the posterior border of some of the hinder dorsal fin-rays. *Egerton Coll.*

Macrosemius pectoralis, Sauvage.

1883. *Macrosemius pectoralis*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. xi. p. 477, pl. xii. fig. 17.

Type. Nearly complete fish; counterpart in British Museum.

A very small species, attaining a length of about 0·055. Head with opercular apparatus considerably longer than its maximum depth, and occupying about one-third of the length of the fish to the base of the caudal fin; caudal pedicle very slender, its width

considerably less than one half the maximum depth of the abdominal region. Vertebral rings well ossified. Dorsal fin arising opposite the fourth or fifth vertebra, with about 26 rays, which are not expanded, but bifurcate distally at least in its hinder half. Pelvic fins arising midway between the pectoral and caudal fins, and the anal, with 6 or 7 rays, shortly behind. Squamation very thin.

Form. & Loc. Portlandian: Meuse, France.

P. 7359. Counterpart of type specimen; Upper Portlandian ("La Garde"), Savonnières-en-Perthois, Meuse. The vertebral rings are shown to be complete and well ossified, and the neural arches throughout the trunk, the hæmal arches in the caudal region, besides all the fin-supports, are especially robust. The present writer cannot distinguish more than 26 dorsal and 7 anal fin-rays. The hindermost dorsal rays are clearly proved to bifurcate. Traces of the extremely delicate flank-scales occur above the pelvic fins. *Purchased*, 1894.

Macrosemius andrewsi, A. S. Woodward.

1895. *Macrosemius andrewsi*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 148, pl. vii. fig. 3.

Type. Nearly complete fish; British Museum.

A very small species, about 0·035 in length, closely similar to the preceding but with relatively stouter caudal region. Separate hypocentra and pleurocentra in notochordal sheath. Dorsal fin with about 25 slender rays, arising above the fifth pair of ribs. Pelvic fins arising about midway between the pectoral and caudal fins, and the anal, with 7 or 8 rays, shortly behind. Squamation very thin.

Form. & Loc. Purbeckian: Wiltshire.

P. 6303. The type specimen, in counterpart, described and figured *loc. cit.*; Middle Purbeck, Teffont.
Presented by Rev. W. R. Andrews, 1890.

The following specimens may perhaps indicate a species of *Macrosemius* from the Stonesfield Slate, while two premaxillæ and a maxilla figured by J. Phillips (Geol. Oxford, 1871, p. 180, woodc. xl. figs. 8, 9) may pertain to the same fish; these specimens, however, are insufficient for determination.

P. 3617. Dentigerous bone, probably maxilla, named *Macrosemius brevirostris* by Agassiz (Poiss. Foss. vol. ii. pt. ii. 1844,

7359. Des? & fig? A.S.W. 1918, p. 81, pl. xvii. fig. 7.

18. Enchelyolepis andrewsi, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 80, pl. xvii. fig. 6.

6303. Des? & fig? A.S.W. 1918, p. 81, pl. xvii. fig. 6.

Macrosemius dorsalis, C. R. Eastman, Mem. Carnegie Mus. vol. vi. [1914), p. 406, pl. lxv. fig. 2. — Litho. Stone; Solenhofen. [Imperfect fish; Carnegie Mus., Pittsburgh.]

1898. *Petalopteryx syriacus*, A. S. Woodward, Ann. Mag. Nat. Hist. [7] vol. ii. p. 485.
1942. P. S. A.S.W. 1942 A.M.N.H. (11) 9 p. 558.

p. 166), described and figured by the present writer in Proc. Geol. Assoc. vol. xi. (1890), p. 293, pl. iii. fig. 9; Stonesfield Slate, Stonesfield. *Enniskillen Coll.*

P. 957. Left dentary with eight teeth, probably of the same species; Stonesfield. *Egerton Coll.*

The following species is only imperfectly defined and is not represented in the Collection:—

Macrosemius helencæ, V. Thiollière, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. (1850), p. 135, and Poiss. Foss. Bugey, pt. ii. (1873), p. 14, pl. vi. fig. 2; H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. xi. (1883), p. 478.—Lower Kimmeridgian (Lithographic Stone); Cirin, Ain, France. [Imperfect small fish; Lyons Museum.] P. de Saint-Seine 1949, N. Arch. Mus. N. H. Lyon 2 p. 143, fig. 84-86 pl. xx-xxi-B, C. in L. notogogus margaritae p. 189.

Genus **PETALOPTERYX,** Pictet.

[Poiss. Foss. Mt. Liban, 1850, p. 20.] near Heterolepis a.s.w. 1942 p. 555.

Syn. ~~*Aphanepygus*, F. Bassani, Verhandl. k. k. geol. Reichsanst. 1879, p. 162.~~

Trunk much elongated, gradually tapering from the occiput backwards; head small, snout acute. Teeth much elongated, closely arranged; suborbital plates subdivided into numerous small tesseræ. Fulcra absent, except on the caudal fin; pectoral fins much enlarged; dorsal fin consisting of unbranched rays, arising shortly behind the occiput and extending continuously to the caudal pedicle; [anal fin apparently absent; caudal fin scarcely if at all forked]. Squamation robust and extending over the whole trunk, the flank-scales not much (if at all) deepened, but all more or less irregular, and the vertical series apparently sometimes dichotomous dorsally and ventrally. to Aphanepygus p. 183.

Petalopteryx syriacus, Pictet.

1850. *Petalopteryx syriacus*, F. J. Pictet, Poiss. Foss. Mt. Liban, p. 22, pl. iii. fig. 1.

1866. *Petalopteryx syriacus*, F. J. Pictet & A. Humbert, Nouv. Rech. Poiss. Foss. Mt. Liban, p. 54.

1882. *Petalopteryx syriacus*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 268.

Type. Nearly complete fish; Geneva Museum.

The type species, attaining a length of about 0·16. Maximum depth of trunk contained nearly four-and-a-half times in its length

from the pectoral arch to the base of the caudal fin, and exceeding twice the width of the caudal pedicle. Suborbitals subdivided into small hexagonal plates, ornamented with granulations. Dorsal fin comprising more than 45 rays, its anterior portion elevated and as deep as the trunk at its point of origin. Principal flank-scales deeper than broad, smooth, and very finely denticulated on the posterior border. (*Pictet.*)

Form. & Loc. Upper Cretaceous: Mount Lebanon, Syria.

Not represented in the Collection.

Aphanepygus

Petalopteryx dorsalis, (Davis.)

1887. *Petalopteryx dorsalis,* J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. p. 627, pl. xx. fig. 4.

Type. Fish with imperfect fins; British Museum.

A small species, attaining a length of 0·075. Length of head with opercular apparatus exceeding the maximum depth and contained six times in the total length of the fish to the base of the caudal fin; maximum depth of trunk contained nearly six times in its length from the pectoral arch to the base of the caudal fin, and twice as great as the width of the caudal pedicle. Tesseræ on cheek very small, elongated antero-posteriorly, and smooth. [Fins imperfectly known, but] pelvic pair comprised within the first third of the trunk. Scales very small and irregular, all apparently at least as broad as deep, smooth, and not serrated on the posterior margin.

Form. & Loc. Upper Cretaceous: Mount Lebanon, Syria.

P. 4755. Type specimen described and figured by Davis, *loc. cit.*; Hakel. The lower dentition and the cheek-plates are especially well shown in the head; the branchiostegal rays are robust though filiform. There is no evidence as to the nature of the vertebral axis, owing to the thickness of the squamation. The fins are too imperfect for description, and it is impossible to determine whether or not the anal is wanting by accident. The caudal fin-rays distinctly bifurcate once. Except in the posterior half of the caudal region, there is evidence of the dichotomy of the vertical series of scales both dorsally and ventrally; and, as noted by Davis, some of the small scales near the pectoral fins appear to be rounded. *Lewis Coll.*

Arhaeopygus Banks

Type *A. elegans* p. 183

1942. *Arhaeopygus donahi* A.S.W., A.M.N.H. (1) 2 p. 535.

1924. Petal. eleg. G. d'Erasmo, Bollet. Soc. geol. Ital.
vol. xlii, (1923), p. 109, pl. ii. (Chalk, Istria.)
1942. Aphanopygus A. & W., A. m. n. H. (11) 9 p. 559.

Rhynchocodes (error) O. G. Costa Neues Jahrb. 1851 p. 181.

Aphanepygus

Petalopteryx elegans (Bassani).

1879. *Aphanepygus elegans*, F. Bassani, Verhandl. k. k. geol. Reichsanst. p. 163.

1882. *Aphanepygus elegans*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 197, pl. i. figs. 1–9.

Type. Fish with imperfect fins; Austrian Geological Survey Museum, Vienna.

The type species of the so-called genus *Aphanepygus*, attaining a length of about 0·12. Length of head with opercular apparatus exceeding the maximum depth and contained about five times in the total length of the fish to the base of the caudal fin. Tesseræ on cheek very small, quadrangular and often antero-posteriorly elongated. Dorsal fin comprising at least 75 rays, the longest of which are as deep as the maximum depth of the trunk; pelvic fins arising just beyond the end of the first quarter of the trunk. Scales small and irregular, smooth, not serrated on the posterior margin, and the majority broader than deep. (*Bassani.*)

Form. & Loc. Upper Cretaceous: Island of Lesina, Dalmatia.

Not represented in the Collection.

Genus **PROPTERUS,** Agassiz.

[Neues Jahrb. 1834, p. 386.]

Syn. *Rhynchoncodes*, O. G. Costa, Atti Accad. Pontan. vol. v. 1850, p. 317.

Trunk irregularly fusiform, the dorsal margin more or less bent at the origin of the dorsal fin; head large, snout acute. Teeth long and slender. Notochord invested at least in part with very delicate pleurocentra and hypocentra or ring-vertebræ. Fins consisting of distally bifurcating rays; paired fins of moderate size, without fulcra; median fins very large, the dorsal extending more than half the length of the back and divided into two portions, the anal fin short and deep, and the caudal deeply forked; dorsal fin with basal fulcra, the anal and caudal fringed with fulcra. Scales covering the whole of the trunk, in regular series, united by peg-and-socket articulation, and usually pectinated or denticulated at the hinder border; the principal flank-scales somewhat deeper than broad, none of the ventral scales much broader than deep; no enlarged ridge-scales.

Propterus microstomus, Agassiz.

1834. *Propterus microstomus*, L. Agassiz, Neues Jahrb. p. 386.

1833–44. *Notagogus zieteni*, L. Agassiz, Poiss. Foss. vol. ii. pt. i.

pp. 10, 293, pl. xlix. fig. 1. [Imperfect fish; Palæontological Museum, Munich.]

1844. *Propterus microstomus*, L. Agassiz, *ibid.* p. 296, pl. l. figs. 6–8.

1851. *Notagogus zieteni*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 65.

1851. *Propterus microstomus*, A. Wagner, *ibid.* p. 66.

1851. *Propterus gracilis*, A. Wagner, *ibid.* p. 68. [Imperfect fish; Palæontological Museum, Munich.]

1863. *Propterus microstomus*, A. Wagner, *loc. cit.* vol. ix. p. 645.

Type. Fish, wanting part of caudal fin; Palæontological Museum, Munich.

The type species, attaining a length of about 0·09. Length of head with opercular apparatus about equalling the maximum depth of the trunk and contained slightly more than four times in the total length of the fish; the dorsal border gently arched and the maximum depth of the trunk two-and-a-half times as great as the width of the caudal pedicle. Length of the first dorsal fin-ray equalling the depth of the trunk at its point of insertion; the short-based anal fin opposed to the hindermost rays of the dorsal. Scales finely denticulated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria. Portugal -

Not represented in the Collection.

Propterus speciosus, Wagner.

[Plate III. fig. 5.]

1851. *Propterus speciosus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 67, pl. iv. fig. 1.

1863. *Propterus speciosus*, A. Wagner, *loc. cit.* vol. ix. p. 644.

Type. Imperfect fish; Palæontological Museum, Munich.

A species attaining a length of about 0·15. Proportions as in the type species, but the dorsal border irregularly arched, sharply rising above the occiput and bent at the origin of the dorsal fin. The anterior and posterior portions of the dorsal fin comprising about 16 and 13 rays respectively; pelvic fins arising well in advance of a point mid-way between the pectorals and the caudal; the short-based anal fin opposed to the hindermost rays of the dorsal. Scales finely denticulated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37088, 37935. Two fine specimens, in counterpart, exhibiting the principal characters of the species; Solenhofen. The first is shown of the natural size in Pl. III. fig. 5.

Häberlein Coll.

1914. Propterus microstomus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 406, pl. lxii. fig. 3.

1949. P. m. E. A. Vianna, Com. Serv. geol. Portugal 30 p. 13, pl. i. Lustremain of Portugal.

1914. Propterus speciosus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 407, pl. lxiii. fig. 1.

1912. Propterus scacchii, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. [3] vol. xvii. p. 213, pl. iv. f. 3.

1914. Propterus scacchii, G. D'Erasmo, Paleont. Italica, vol. xx, p. 80, pl. ix. fig. 5.

= Cenomanian (Bassani & D'Erasmo).

Propterus coniders, C. R. Eastman, Mem. Carnegie Inst. vol. vi (1914), p. 407, pl. lxii. fig. 2. — Litho. Stone; Solenhofen. [Imperfect fish; Carnegie Inst., Pittsburgh.]

Propterus vidali, H. E. Sauvage, Sc. p. 186 MS.

37099. A large fish, 0·18 in length, with imperfect head and fins, probably of this species; Solenhofen. *Häberlein Coll.*

P. 5547. A small fish; Eichstädt. *By exchange*, 1888.

Propterus elongatus, Wagner.

1863. *Propterus elongatus,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 645.

Type. Fish, wanting squamation; Palæontological Museum, Munich.

A species briefly described as differing only from *P. speciosus* in the more slender proportions of the trunk, which tapers more rapidly behind.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

Not represented in the Collection.

Propterus scacchii (Costa).

[Plate III. fig. 6.]

1850. *Rhynchoncodes scacchi,* O. G. Costa, Atti. Accad. Pontan. vol. v. p. 317, pl. v. fig. 5.

Type. Nearly complete fish; University Museum, Naples.

The type species of the so-called genus *Rhynchoncodes*, of small size, attaining a length of about 0·06. Length of head with opercular apparatus exceeding the maximum depth of the trunk and contained about three-and-a-half times in the total length of the fish; the dorsal border gently arched and the maximum depth of the trunk about three times as great as the width of the caudal pedicle. Length of the first dorsal fin-ray nearly equalling the depth of the trunk at its point of insertion.

Form. & Loc. Upper Jurassic: Naples.

P. 3613. Specimen 0·055 in length, displaying the general form of the fish but much abraded, shown of the natural size in Pl. III. fig. 6; Torre d'Orlando, near Castellamare, Naples. Each part of the dorsal fin seems to have comprised about 10 rays, and the anal fin, with only 6 rays, exhibits large fulcra along its anterior border resembling those of the caudal fin. *Enniskillen Coll.*

To the genus *Propterus*, perhaps also to the species *P. scacchii*, may be referred two small imperfect fishes from the Upper Jurassic of Torre d'Orlando (*errore* "Pietraroja") described under the name

of *Rhynchoncodes macrocephalus*, O. G. Costa, Atti Accad. Pontan. vol. viii. (1864), p. 102, pl. ix. figs. 10, 11. They have already been placed in this genus by F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. (1882), p. 239.

The so-called *Propterus serratus*, Münster MS. (L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1844, p. 296), from the Lithographic Stone of Bavaria (type in Berlin Museum), is undefined.

Genus **NOTAGOGUS,** Agassiz.

[Poiss. Foss. vol. ii. pt. i. 1833–44, pp. 10, 293.]

Syn. *Blenniomoeus*, O. G. Costa, Atti Accad. Pontan. vol. v. 1850, p. 319.
Calignathus, O. G. Costa, *ibid.* vol. vii. 1853, p. 37.

A genus scarcely distinguished from *Propterus*, differing only in the non-elongation of the anterior rays of the dorsal fin, which are very widely spaced, and in the less deeply forked character of the caudal fin. The vertebral rings also appear to be more robust than in *Propterus*.

Notagogus pentlandi, Agassiz.

[Plate III. figs. 7, 8.]

1833–44. *Notagogus pentlandi*, L. Agassiz, Poiss. Foss. vol. ii. pt. 1. pp. 10, 294, pl. xlix. fig. 2.
1833–44. *Notagogus latior*, L. Agassiz, *ibid.* pp. 10, 294, pl. xlix. fig. 3. [Distorted fish; Paris Museum of Natural History.]
1850. *Notagogus pentlandi*, O. G. Costa, Atti Accad. Pontan. vol. v. p. 312, pl. v. fig. 2, pl. vii. fig. 5.
1850. *Notagogus erythrolepis*, O. G. Costa, *ibid.* p. 314, pl. iv. figs. 6, 7.
1850. *Notagogus minor*, O. G. Costa, *ibid.* p. 315, pl. v. fig. 4.
1850. *Blenniomoeus longicauda*, O. G. Costa, *ibid.* p. 319, pl. vi. fig. 2.
1850. *Blenniomoeus brevicauda*, O. G. Costa, *ibid.* p. 321, pl. v. fig. 3.
1853. *Blenniomoeus major*, O. G. Costa, *ibid.* vol. vii. p. 34, pl. ii. figs. 4–6.
1864. *Notagogus pentlandi*, O. G. Costa, *ibid.* vol. viii. p. 72, pl. xii. fig. 5.
1864. *Notagogus crassicauda*, O. G. Costa, *ibid.* p. 74, pl. xii. figs. 6, 7.
1864. *Blenniomoeus longicauda*, O. G. Costa, *ibid.* p. 99.
1864. *Notagogus erythrolepis*, O. G. Costa, *ibid.* p. 102, pl. xi. fig. 11.
1864. *Notagogus gracilis*, O. G. Costa, *ibid.* p. 103, pl. xi. fig. 8.
1882. *Notagogus pentlandi*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. pp. 237, 239.

Type. Nearly complete fish; British Museum.
A species attaining a length of about 0·15, but usually smaller.

Rh. macrocephalus = *Propterus scacchii*, F. Bassani & G. D'Erasmo, *loc. cit.* 1912, p. 213.

1896. *Propterus serratus*, H. Seupin, Archiv f. Naturgesch. vol. i. p. 170 [structure of scale].

Propterus vidali, Sauvage.

1903. *Propterus vidali*, H. E. Sauvage, Mem. R. Acad. Ciencias Barcelona [3] vol. iv. no. 35, p. 9, pl. ii. fig. 1.

1966. P. V., J. R. Bataller, B.S. Inst. Sci. España 67 : 114 pl. xiv f. 1

Includes *Lepidotus exiguus* : see p. 124, ms.

1912. *Notagogus pentlandi*, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. XL [3] vol. xvii, p. 206, pl. iii. f. 1,2; pl. iv. f. 1,2; pl. v. f. 1; text-figs. 1-6.

1914. *Notagogus pentlandi*, G. D'Erasmo, Paleont. Italica, vol. xx, p. 75, pl. ix. figs. 1-4, text-figs. 12-15.

= Cenomanian (Bassani & D'Erasmo).

Length of head with opercular apparatus considerably exceeding the maximum depth of the trunk and equalling half its length to the base of the caudal fin; width of caudal pedicle somewhat less than half the maximum depth of the trunk, which tapers gradually from a point close to the occiput. Dorsal fin arising at the end of the first quarter of the back, and its anterior portion twice as much extended as the hinder portion; the first comprising about 14 rays, very widely spaced and all shorter than those of the second portion, which are more closely arranged and only 10 in number. Anal fin, with large fulcra and about 6 rays, as deep as the second portion of the dorsal and arising slightly behind the origin of the latter. Scales very finely crenulated.

This is commonly regarded as the type species of *Notagogus*.

Form. & Loc. Upper Jurassic: Naples.

117. Type specimen; Torre d'Orlando, near Castellamare. *Purchased*, 1837.

P. 2065. Finer specimen 0·14 in length, shown of the natural size in Pl. III. fig. 7; Torre d'Orlando. *Egerton Coll.*

P. 6866. Impression of a large fish distorted at the lower margin of the abdominal region, apparently the counterpart of the type specimen of the so-called *N. latior*; Torre d'Orlando. *Presented by Walter Crouch, Esq.*, 1893.

P. 1097. Three imperfect young specimens, the largest about 0·06 in length, exhibiting the internal skeleton of the trunk; Torre d'Orlando. The middle portion of the vertebral axis of one specimen is shown of three times the natural size in Pl. III. fig. 8. The pleurocentra and hypocentra are observed to be distinct posteriorly, but soon fused together in the abdominal region. *Egerton Coll.*

Notagogus denticulatus, Agassiz.

1844. *Notagogus denticulatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 294, pl. l. figs. 1–5, pt. ii. p. 289.
1851. *Notagogus denticulatus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 65.
1863. *Propterus denticulatus*, A. Wagner, *ibid.* vol. ix. p. 646.
1881. *Notagogus denticulatus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 43.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species attaining a length of about 0·1. Proportions of head and trunk as in *N. pentlandi*, except that the trunk in the abdo-

minal region is slightly deeper. Anterior portion of dorsal fin nearly twice as much extended as the second portion, both about equally elevated and the first three rays of each more approximated than the others; the anterior portion with about 13 rays, the posterior portion with not less than 11 or 12 rays, which are somewhat less widely spaced. Anal fin arising opposite the middle of the hinder portion of the dorsal. Scales conspicuously denticulated, except those of the pectoral region, which are more or less cycloidal.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 3610–11. Two specimens, the first with imperfect head, the second very fragmentary and chiefly in impression; Kelheim, Bavaria. *Enniskillen Coll.*

P. 1089. Another imperfect specimen exhibiting the rounded scales in the pectoral region; Kelheim. *Egerton Coll.*

P. 1090. Small fish about 0·055 in length, probably young of this species; Kelheim. *Egerton Coll.*

Notagogus inimontis, Thiollière.

1850. *Notagogus Imi montis*, V. Thiollière, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 137.
1858. *Notagogus iunismontis*, V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. p. 783 (name only).
1873. *Notagogus inimontis*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 15, pl. vi. fig. 3.
1893. *Notagogus inimontis*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. p. 428.

Type. Nearly complete fish; Lyons Museum.

A species doubtfully distinct from *N. denticulatus*, but described by Sauvage as separated by its relatively larger teeth and steeper facial profile of the head.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 4692. Trunk without head; Cirin, Ain. *Purchased*, 1884.

Notagogus macropterus, Vetter.

1881. *Notagogus macropterus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 46.

Type. Fish, wanting caudal fin; Dresden Museum.

A species closely related to *N. denticulatus*, described as differing

914. Notogogus inimontis, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 365, pl. xlix. fig. 2, pl. 1. figs. 1, 2.

949. N. i. P. de Saint-Seine. N. arch. Mus. H.N. Lyon 2me p. 205 fg. 90-98, pl. xxi f.c.

965 Notogogus ferreri S. Weiss Bull. Soc Géol de France (7) VI 1964

Varbyichthys latus, g.9.s.n. Jurassic,
Talbragar, R.T. Wade 1941. J. Proc. R.S. N.S.W.
75 p. 82; 1953. J. Proc. R.S.N.S.W 87 p. 63 figs 12 pl.
viii. Austr. Mus. Imp. fish.

U. incertus sp. nov R.T. Wade 1953 J. Proc. R.S.N.S.W 87 p. 11, pl. ix [do. id.

Notagogus decoratus, C.R. Eastman, Mem. Carnegie Mus. vol. vi (1914), p. 407, pl. Txviii. fig. 2. — Litho. Stone; Solenhofen. [Imperfect fish; Carnegie Mus., Pittsburgh.]

Notagogus ornatus, C.R. Eastman, Mem. Carnegie Mus. vol. vi (1914), p. 366, pl. T. fig. 3. — Litho. Stone; Cirin, Ain. [Fish; Carnegie Mus., Pittsburgh.]

Notagogus parvus, R.H. Traquair, Poiss. Weald. Berniszart (Mém. Mus. Roy. Hist. Nat. Belg. vol. v. 1911), p. 26, pl. iv. text-fig. 10. — Wealden; Berniszart, Belgium. [Imperfect fish; Roy. Mus. Nat. Hist. Brussels.]

Notagogus minutus, C.R. Eastman, Proc. U.S. Nat. Mus. vol. 7ii (1917), p. 287, pl. xiv. fig. 4. — Litho. Stone; Solenhofen. [Fish; U.S. Nat. Mus.]

Notagogus incertus ante p. 311.

A. Smith. B.G. Gardiner 1995 Proc. Int. Congr. Zool. 15, 5: 436 ff.

in the more arched form of the back, deeper trunk, and the remarkable development of the pectoral, dorsal, and anal fins.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

Not represented in the Collection.

A fish from the Lithographic Stone of Cirin, Ain, France, much resembling the two preceding species, is named *N. margaritæ*, Thiollière (Bull. Soc. Géol. France, [2] vol. xv. 1858, p. 783), and figured without description in Thiollière, Poiss. Foss. Bugey, pt. ii. (1873), pl. vi. fig. 4. = Macrosemius helenae p. 181.

Either to the Macrosemiidæ or to the Semionotidæ may also perhaps be referred the problematical Triassic genus *Orthurus* (R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. 1866, p. 163). The trunk is comparatively elongated and is almost or quite scaleless on the flanks. A few of the inner teeth are enlarged and tritoral. There is little or no ossification in the notochordal sheath, and the ribs are extremely delicate. The pectoral fins are large and the pelvic fins remote; the dorsal fin has an extended base-line but is not acuminate, and the anal is relatively very small; the caudal fin is truncated, not forked. A few undivided and unarticulated rays occur at the origin of the dorsal and caudal fins, but ordinary fulcra are absent. All the fin-rays are delicate, and those of the dorsal and anal fins, though articulated, are not branched more than once. An elongated large scale occurs in front of the anal fin. The type species, *O. sturi* (Kner, *loc. cit.* p. 163, pl. ii. fig. 1), is founded on a unique specimen from the Keuper of Raibl, Carinthia, in the Museum of the Austrian Geological Survey, Vienna. Another form from the "Hauptdolomit" of Lumezzane, Lombardy, is also described by W. Deecke, Palæontogr. vol. xxxv. (1889), p. 136, pl. vii. fig. 9.

Family PYCNODONTIDÆ.

Trunk deeply fusiform or cycloidal. Cranial bones robust, and a median occipital plate separating the parietal elements; facial bones delicate or wanting; opercular apparatus reduced to a small operculum, large preoperculum, and not more than two branchiostegal rays; mandibular suspensorium much inclined forwards and gape of mouth small; teeth prehensile on the premaxilla and dentary, wanting on the maxilla (if this bone be present) and the pterygopalatine arcade, tritoral on the single vomer and the splenials; all

the teeth apparently without vertical successors. Notochord persistent, destitute of ossifications in its sheath. Fin-rays robust, the majority well-spaced and articulated; fulcra absent, except perhaps quite at the base of the caudal fin; dorsal and anal fins more or less extended. Scales rhombic when present, frequently wanting on the whole or part of the caudal region; almost invariably strengthened by the inner rib on their anterior margin and united by a peg-and-socket articulation in connection therewith.

The cranial osteology of the Pycnodont fishes is as yet very imperfectly known. The little information available suggests that there was as much variation in this group as in certain aberrant tribes of modern fishes, such as the Plectognaths and Gymnodonts; and in any general description it is therefore necessary to state precisely in which genus or genera several of the characters have been observed. When this statement is not made in the following account, the character in question has been met with very widely and may be regarded as normal in the family. The best-preserved specimens hitherto obtained are those of *Mesturus leedsi* from the Oxford Clay of Peterborough. The laterally-compressed examples of *Gyrodus* and *Mesodon*, from the Lithographic Stone of Bavaria and France, are also important; while the unique specimen of *Anomœodus willetti* from the Sussex Chalk (see p. 263) reveals for the first time the pterygo-palatine arcade.

The chondrocranium is well ossified and always completely covered with membrane-bones, there being no vacuities in the cranial roof. The basicranial axis is more or less parallel with the roof behind the angulation of the frontal profile, and is then bent sharply downwards to the dentigerous oral face of the vomer; while the latter is finally directed in a plane almost parallel with the first. The axis of the skull as a whole is directed downwards and forwards, making a considerable angle with the axis of the trunk.

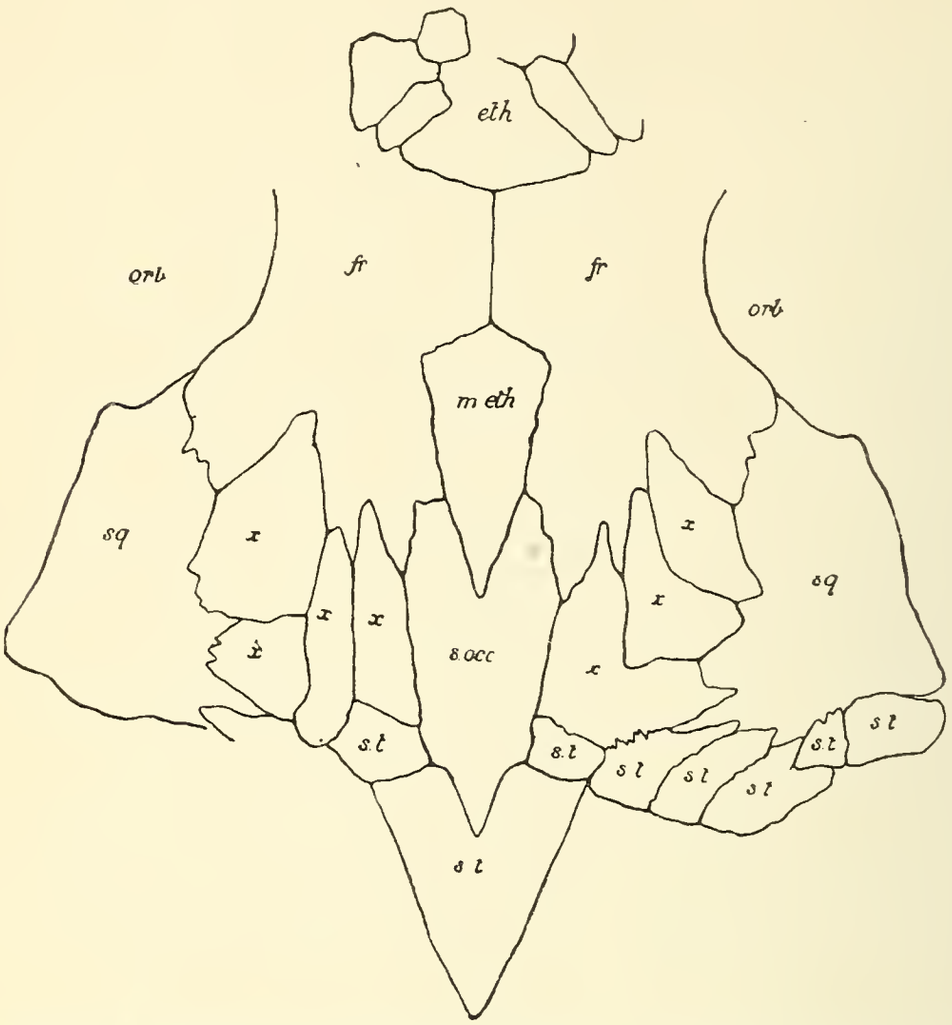
Of the chondrocranial elements, only the postfrontal (sphenotic), mesethmoidal, and supposed basisphenoidal bones have hitherto been clearly observed. The postfrontal in *Mesturus* is small and does not appear on the cranial roof; nor is there any external ornamented plate fused with its outer face. Its lower extremity meets the basipterygoid process of the parasphenoid in a deeply interdigitating suture; while its posterior outer face takes part in the facette for the upper end of the hyomandibular. The mesethmoid is always conspicuous as a deep thin lamina extending forwards from the anterior border of the orbital cavity and articulating below

with the median ridge on the superior aspect of the coalesced vomers: it can be distinguished from this plate by the arrangement of its structural fibres, which are directed downwards and forwards instead of horizontally, and it never projects in advance of the vomers in the rostrum. There is no ossified interorbital septum. It is evident from several specimens, notably *Anomœodus willetti* and *Mesturus leedsi*, that the base of the cranium bears a delicate, laminar, median vertical keel extending as far forwards as the orbit; but the only precise information concerning the basicranial axis has been obtained from specimens of *Mesturus leedsi*. The basioccipital is unknown, but a detached element, evidently chondrocranial, in no. P. 6834 recorded below, fits well on the hinder margin of another bone in the same fossil which is proved to be parasphenoid. It may therefore be determined as basisphenoid, and is noteworthy as occupying a considerable length of the basicranial axis. It is longer than broad, exhibits a median longitudinal keel below, and is narrowest at its hinder end; while the lateral margins form sharp edges, each apparently notched near its anterior end, and a pair of large foramina pierce the bone obliquely near its middle. The parasphenoid is remarkable for its shortness, not extending backwards beyond the front edge of the supposed basisphenoid. The main part of the bone is short, stout, and broad, with a median longitudinal keel below; and its basipterygoid processes are short, with the very coarsely dentated articular end already mentioned. At the front extremity of the otic region this broad bone is abruptly truncated, its inferior keel terminates in a roughened pointed knob, and the element continues merely as a narrow slender median bar across the region of the orbit; towards the front of the orbit in many fossils a vertical median lamina is observed to rise gradually on its superior face to meet the ascending plate of the coalesced vomers. The latter form one very stout, bilaterally symmetrical bone extending to the anterior end of the rostrum, where they are overlapped by the small premaxillæ.

The arrangement of the membrane-bones (or dermal plates) of the cranial roof is not quite constant, and there is much irregularity especially in the superficial elements covering the ethmoidal region. As shown by *Mesturus* (fig. 30), the posterior median element of the roof is bilaterally symmetrical and unpaired, and may therefore be named supraoccipital (*s.occ.*). The frontals (*fr.*) are the largest plates, always conspicuous and readily identified between the orbits, and varying in length according to the shape of the head. The otic region is covered by a single plate, which forms the postero-lateral angle of the roof and meets the frontal anteriorly, entering

to some extent the superior border of the orbital cavity; this in our nomenclature is evidently the squamosal (*sq.*). In the majority of Pycnodonts, the space between the supraoccipital, frontal, and squamosal elements is occupied on each side by a single parietal

Fig. 30.



Mesturus leedsi; diagram of bones of cranial roof, superior aspect, from a specimen in the collection of Alfred N. Leeds, Esq., Eyebury.—Oxford Clay; Peterborough.

eth., ethmoidal plates; *fr.*, frontal; *m.eth.*, median ethmoidal plate; *orb.*, orbit; *sq.*, squamosal; *s.occ.*, supraoccipital; *s.t.*, supratemporal; *x*, plates in parietal region.

plate; while this plate in *Mesodon*, *Microdon*, *Stemmatodus*, *Cœlodus*, *Palæobalistum*, and *Pycnodus* exhibits a large posteriorly-directed process with digitate extremity, arising about the middle of its hinder margin and extending immediately beneath the scales of the trunk. In *Mesturus leedsi*, however, the parietal region is occupied by two or more irregular plates on each side (*x*); and neither in this genus nor in *Gyrodus* is there any posteriorly-directed process. The ethmoidal plates, as shown in *Mesturus leedsi*, are most remarkable (*eth.*). The region in advance of the frontals is covered with polygonal tesseræ, which extend even over the smooth premaxillæ;

and these tesseræ frequently fuse together. One median plate thus formed extends backwards between the anterior ends of the frontals, and these elements are sometimes entirely separated by it; moreover, this median series is even continued further back by another azygous plate (*m.eth.*) which meets (or is fused with) the supraoccipital. The arrangement of azygous median plates in the cranial roof of *Mesturus leedsi* is thus suggestive of the corresponding plates in Acipenseroid fishes. In *Coccodus* all the elements of the cranial roof are fused into one continuous shield.

The cheek-plates are small, thin, and apparently without any very definite arrangement. In *Mesturus* and *Gyrodus* one plate larger than the remainder, bounding the upper jaw, may be the maxilla; but it is delicate and toothless. The premaxillæ are a pair of small, deep and narrow bones, moderately thick, resting upon the anterior extremity of the vomer, and covered with the ethmoidal dermal plates. The postero-external border of each is notched, as if for the opening of the nasal capsule. The sclerotic capsule is often ossified.

The hyomandibular is a long narrow lamina about twice as broad above as in its lower half, with a posterior process near its upper end for the support of the operculum (Pl. XVI. fig. 3, *hm.*); but nothing is known of its connections below. The pterygo-palatine arcade is delicate and toothless, and is shown both in *Anomœodus willetti* and *Mesturus leedsi* to have been directly fused for a considerable distance with the edge of the basicranial axis. The thickened articular end of the quadrate is turned forwards so that the facette for the mandible is in a vertical plane; and this facette is irregularly oval, deeper than broad, and slightly concave. The free border of the ectopterygoid is concavely arched; and there is not much doubt that a distinct symplectic element was apposed to the hinder margin of the quadrate, though this still remains to be definitely proved. The two rami of the mandible are separate at the symphysis, and in *Mesturus leedsi* each is observed to consist of five elements. The proximal end of the meckelian cartilage is distinctly ossified as an articular bone; and there is a very large splenial element within, while three more delicate splints appear without. The splenial is much the largest and stoutest bone in the jaw, meeting its fellow of the opposite side at the symphysis and well covered with a pavement of teeth on its oral face. It is exposed on the outer aspect of the entire margin of the ramus behind the short oral border of the dentary, and rises posteriorly into a large coronoid process. The dentary is comparatively insignificant, thin, deep and narrow, meeting its fellow at the

symphysis, and bearing a row of prehensile teeth. An angular plate, though not extending upwards quite to the oral border, completes the posterior part of the outer face of the mandibular ramus; and its hinder ascending portion meets a small coronoid bone, with which it frequently becomes fused. The hyoid elements are not satisfactorily known, though in *Mesturus verrucosus* a short and deep ceratohyal with a small hypohyal is evidently observed (Pl. XV. fig. 1, *ch.*, *hy.*).

The opercular and branchiostegal apparatus is remarkably reduced. The operculum is relatively small, deep, and narrow, truncated above where it meets the postero-lateral edge of the cranial roof, and tapering below to a point. This bone has hitherto been named "supraclavicle," but its true nature is indicated both by a specimen of *Gyrodus hexagonus* (Pl. XVI. fig. 3) and by one of *Mesturus leedsi* (no. P. 6834). The preoperculum (commonly termed "operculum") is very large, triangular in shape and much expanded below; its mode of attachment to the mandibular suspensorium is indicated in the specimens both of *Anomœodus willetti* and *Gyrodus hexagonus* already referred to. The suboperculum and interoperculum are wanting; and only two branchiostegal rays have been observed immediately below the preoperculum in *Mesturus leedsi* and in *Gyrodus frontatus* (Pl. XVI. fig. 2). In *Gyrodus* and *Mesturus* the space between the rami of the mandible is completely covered with small polygonal tesseræ, there being no gular plate. On the branchial arches, long and slender calcified gill-filaments, more or less denticulated, are often observed.

Teeth are confined to the vomer, splenial, premaxilla, and dentary. They are all hollow, with a short base firmly anchylosed to the supporting bone; and the present writer has never observed any provision for replacement. The only suspicion of such an arrangement is afforded by the Oxfordian specimens of *Mesturus leedsi*. The teeth of the premaxilla and dentary are prehensile and arranged in a single series; those of the vomer and splenial are tritoral and form an extended pavement. Anteriorly the teeth of these pavements are nearly equal in size and do not exhibit any very definite arrangement; but posteriorly as a rule they soon become differentiated and disposed in regular longitudinal series of more or less different sizes. Appearances suggest that the splenial and vomerine elements are continually being lengthened by growth behind, the only new teeth obtained during the life of the animal being those added in this manner. If so, it is much the same kind of growth as that which takes place in the dentition of the Cochliodontidæ and Myliobatidæ among Elasmobranchs: the only differences being due

Hennig determines successional teeth in vomer of Palaeobalistum ventralis, Centralbl. f. Min. 1907, p. 363, fig. 2.

to the presence of a bony base in the one case and its absence in the other. Moreover, in comparing the detached vomers and splenials of Pycnodonts, the smaller specimens cannot be compared as a whole with the larger ones—they must be compared only with that portion of the latter which happens to be of corresponding size.

The notochord is always persistent, and no ossifications which can be ascribed to its sheath have hitherto been observed. The neural and hæmal arches, however, are invariably well-ossified, and their bases are so much expanded that they sometimes (*Palæobalistum*, *Pycnodus*) completely encircle the notochord. Ribs are present; and those of *Gyrodus* and *Palæobalistum* are distinctly observed to exhibit the laminar expansion so characteristic of the neural spines throughout the trunk and of the hæmal spines in the caudal region. This expansion is commonly confined to the anterior edge of each spine, but in *Gyrodus* and *Palæobalistum* it occurs both anteriorly and posteriorly; and in the last-mentioned genus the laminæ of adjacent spines are actually united for a considerable length in a jagged suture. The neural spines in the abdominal region extend to the dorsal margin of the fish, and are often thickened apparently for the support of the ridge-scales. The hæmal spines supporting the caudal fin are also more or less expanded, but never fused together. No intermuscular bones have been seen.

The precise mode of suspension of the pectoral arch to the cranium still remains to be discovered; but the clavicle is well known, and some specimens of *Gyrodus* appear to exhibit a supra-clavicle extending towards the back of the cranial roof. The clavicle is much vertically elongated, tapering above, and with a spatulate expansion below; a very small surface is exposed on the flank of the fish. There is no infra-clavicle. The scapula and coracoid cannot yet be described, but the pectoral fin is attached just above the inferior expansion of the clavicle. The base of this fin forms a little lobe, distinctly covered with thin rounded scales in *Gyrodus*; and a single series of seven or eight basals can be readily counted in specimens both of *Gyrodus* and *Palæobalistum*, while some vacant space may have been occupied by still more of these elements. The pelvic fins, though often quite rudimentary, are exhibited in all the genera of which the trunk is satisfactorily known. The rays of the dorsal and anal fins are equal in number to their supports, which are more numerous than the vertebral arches in the same region; but each fin-ray is sometimes liable to be subdivided into its right and left halves by crushing, and there

is then a false appearance of multiplicity of rays. All the rays are more or less articulated, and they also usually bifurcate; but there are no traces of fulcra, unless a few short, undivided basal rays at the origin of the caudal fin are placed in this category.

The scales are all quadrangular and somewhat deepened on the flank. Their anterior margin is strengthened by a vertical inner rib, which forms a peg-and-socket articulation to unite the scales of each transverse (vertical) series; and there is one exceptional instance (*Mesturus*) in which this union is still further strengthened by an interlocking jagged suture of the superposed upper and lower margins. The series are for the most part regular; but in *Mesturus* there are a few, short, irregular intercalary series both dorsally and ventrally, while in this genus, *Gyrodus*, and *Palæobalistum* there is a fine subdivision of the scales at the base of the dorsal and anal fins. When the squamation degenerates on the caudal region, it does not appear to pass through the stage represented in the Dapedioid genus *Aetheolepis* (see p. 157); the rhombic scales seem to disappear directly without first becoming cycloidal, for remnants of their anterior thickened rib are often observed on the otherwise naked tail. The "lateral line" extends along the flank from the outer supratemporal to the middle of the caudal pedicle; and there is also always an upper canal passing along the top of the flank to the origin of the dorsal fin. The ridge-scales are usually small and inconspicuous; but in *Palæobalistum* and *Pycnodus* those of the ventral ridge appear to have considerably extended limbs.

The hinder end of the abdominal cavity is nearly always marked by a long, curved bone, extending from a slight expansion at the ventral border just in advance of the anal fin, and tapering to a point immediately below the notochordal axis. In *Gyrodus* (Pl. XVI. fig. 2, *x*) this has much the aspect of an azygous internal bone (as described by B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, p. 36); while in *Cœlodus*, *Palæobalistum* and *Pycnodus* it appears rather as a great paired dermal scute (as described by J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. 1856, pp. 216, 221, 241). The element is certainly not an enlarged support of the anal fin, and has no connection with the pelvic fins. It must still remain problematical.

In arranging the genera of Pycnodonts, the presence or absence of scales on the caudal region cannot be regarded as of prime importance, owing to the uncertainty of the character in some degree in *Microdon* and in a greater degree in *Palæobalistum*. Specialization seems to result chiefly (i.) in the strengthening of the backbone by the interlocking of its arches; (ii.) in the reduc-

Affinities (& origin) of the Pycnodonts
A. S. Woodward 1939, Ann. Mag. N.H. (11)
IV. 607. Hobbins Smithsonian 1946. Tr. Kans
Acad. Sci. 47 p. 1004-, & Bobasatania, LP
Lehman 1956 Ann. Pal. 42, 65 ff.

Hadrodus priscus q. & g. n. J. Leidy 1857
Proc. Philad. Acad. Nat. Sci. p. 167.
1873. Rep. U.S. Geol. Surv. Territories
1 p. 294 pl. 19 f. 17-20. ? Chalk: Minnisota

Hadrodus marshi S.G. & Gen. Nov. Kenna
J. T. Gregory 1950 Postilla Yale Peabody
Mus. N.H. 5 p. 1. 2 ff.

Incl. Hylaeobates see vol. 1 p. 131

tion of the tritoral teeth to a fixed arrangement in regular longitudinal series; and (iii.) in the obliteration of the indent for the meckelian cartilage on the attached face of the splenial bone. Very rarely (*Coccodus*, *Xenopholis*) a spinous dermal armour is also developed. Finally, we venture to recognize one case of degeneracy of the tritoral dentition (*Anomœodus*).

Synopsis of Genera.

I. Neural and hæmal arches of axial skeleton of trunk not expanding sufficiently to encircle the notochord.

(*a.*) Number of longitudinal series of teeth on splenial bone inconstant; caudal fin rounded; no dermal spines.

Vomerine teeth in five longitudinal series, sometimes irregular laterally; splenial dentition comprising one regular principal series, with three or more outer series and one or two inner series, usually irregularly arranged; scales tuberculated, confined to region in advance of median fins ..... *Mesodon* (p. 199).

[Splenial dentition as in *Mesodon*, but usually much more irregularly arranged, and the principal longitudinal series not well-differentiated; the splenial bone much stouter, and with a remarkably deep symphysial facette; fish unknown ..... *Athrodon* (p. 215).]

Vomerine teeth in three regular longitudinal series, with irregular intermediate series; splenial dentition with two regular series separated by small teeth, and flanked within by other small teeth; scales covering whole of trunk, united above and below with jagged sutures ..... *Mesturus* (p. 218).

(*b.*) Number of longitudinal series of teeth on splenial bone constant; caudal fin forked; no dermal spines.

Vomerine teeth in five longitudinal series, the inner lateral pairs regularly alternating with the widely-spaced median teeth; splenial teeth in four regular series; squamation confined almost or completely to region in advance of median fins ..... *Microdon*, p. 221).

Vomerine teeth in five, and splenial teeth in four regular longitudinal series; scales covering whole of trunk, and none united with jagged sutures .... *Gyrodus* (p. 233).

Vomerine teeth in five, and splenial teeth in three regular longitudinal series; squamation confined to region in advance of median fins; caudal fin scarcely forked ..... *Stemmatodus* (p. 248).

Oral surface of vomer convex from side to side, and teeth in five regular longitudinal series; splenial teeth in three series, the outer sometimes in part subdivided, the inner sometimes irregularly supplemented; squamation confined to region in advance of median fins ..... *Cœlodus* (p. 249).

(*c.*) Splenial dentition comparatively degenerate, restricted to a space well within outer margin, and number of longitudinal series inconstant; no dermal spines.

Vomerine teeth irregular, in from three to five longitudinal series; squamation confined to region in advance of median fins ..... *Anomœodus* (p. 258).

(*d.*) Abnormal genera with median occipital spine, and more or less spinous pectoral arch.

Vomerine teeth apparently in five, and splenial teeth in three regular longitudinal series; clavicular spines large; scales wanting..... *Coccodus* (p. 266).

Imperfectly known, but greater portion of trunk covered with large, rhombic, keeled scutes ..... *Xenopholis* (p. 269).

II. Neural and hæmal arches of axial skeleton of trunk expanding and completely encircling the notochord.

Vomerine teeth in five, and splenial teeth in three regular longitudinal series; caudal pedicle very short, and fin fan-shaped; squamation variable ..... *Palæobalistum* (p. 270).

Dentition as in *Palæobalistum*; caudal pedicle slender and fin slightly forked; squamation confined to region in advance of median fins ..... *Pycnodus* (p. 275).

Mesodon parvus, A. S. W.

1895. Mesodon macropterus, var. parvus, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 147, pl. vii. fig. 2.

1918. Mesodon parvus, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 52, pl. xii. figs. 3, 4.

Type. Nearly complete fish; British Museum.

Form. & Loc. Middle Purbeckian: Tetford, Wiltshire.

P. 9845. Type specimen, des? & fig? loc. cit. 1895, and loc. cit. 1918, p. 52, pl. xii. fig. 3.
Pres? by Rev. W. R. Andrews, 1903.

P. 10954. Well-preserved fish lacking caudal fin, des? & fig? loc. cit. 1918, p. 53, pl. xii. fig. 4.
Pres? by J. T. Getting, Dec. 1911.

Mesodon bernissartensis, Traquair

1911. Mesodon bernissartensis, R. H. Traquair, Poiss Wealdi. Bernissart (Ann. Mus. Roy. Hist. Nat. Belg. vol. v), p. 29, pl. v. text-f. 11, 12.

1918. Mesodon bernissartensis, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 49.

960. M. b. E. Casier, Les Ganoïdes de Bernissart pl. 27, 28.

Stenchia Pictet. S. Thomas et 1830; figs 1a, b, 5 9a.

Macromesodon, J. F. Blake, Mon. Fauna Cornbrash (Pal. Soc. 1905), p. 32.

1906. Mesodon macropterus, E. Hennig, Palaeontogr. vol. lviii. p. 172, text-fig. 8.

1906. Mesodon, E. Hennig, loc. cit. p. 201, text-fig. 14.

1917[-18] Mesodon macropterus, A. S. Woodward, Geol. Mag. [6] vol iv, p. 386, text-fig.; also Foss. Fishes Weald & Purb. Form. (Pal. Soc.), p. 49, text-fig. 20. [Restoration]

1914. Mesodon macropterus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 408, pl. lxi. figs. 1, 2.

Genus **MESODON**, Wagner [1].

[Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. 1851, p. 56.]

Syn. (?) *Typodus*, F. A. Quenstedt, Der Jura, 1858, p. 781.

Trunk discoidal, not produced at the caudal pedicle. Head and opercular bones externally ornamented with granulations; cleft of mouth very oblique; teeth smooth, or with feeble indentation and rugæ; vomerine teeth arranged in five longitudinal series, the lateral pairs being often irregular; splenial dentition comprising one principal series of teeth with three or more outer series and one or two inner series, usually irregularly arranged. Neural and hæmal arches of axial skeleton not sufficiently expanded to meet round the notochord. Fin-rays robust, closely articulated, and much divided distally. Pelvic fins present; dorsal and anal fins deep throughout their extent, the former occupying the hinder half of the back, and the latter somewhat shorter; caudal fin fan-shaped, having a convex hinder margin, and arising immediately between the posterior extremities of the dorsal and anal fins. Scales robust, ornamented with granulations, and occupying only the anterior half of the trunk.

Of this genus many species are known only by the dentition, and in that case they cannot be satisfactorily defined. The form of the teeth is especially variable, but the number and relative proportions of the several series appear to be sufficiently constant for noting in provisional definitions.

Mesodon macropterus (Agassiz).

[Plate XVI. fig. 1.]

1834–44. *Gyrodus macropterus*, L. Agassiz, Poiss. Foss., Feuill. p. 18, and vol. ii. pt. ii. p. 301.

1851. *Mesodon macropterus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. pp. 49, 56, pl. iv. fig. 2.

1856. *Mesodon macropterus*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 202.

1862. *Mesodon macropterus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 349.

1887. *Mesodon macropterus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 247, fig. 261.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·16. Maximum

[1] This name having gained universal acceptance, we adopt it, notwithstanding its preoccupation among Mollusca by *Mesodon*, Rafinesque, 1819.

depth of the trunk nearly equal to the length of the head and trunk without caudal fin ; distance from frontal angulation to hinder margin of preoperculum equalling about one-quarter of the total length of the fish. [Dentition imperfectly known, but] teeth smooth, some indented, and those of the principal mandibular series at least twice as broad as long. Dorsal and anal fins equally elevated, the latter with about 30 rays and four-fifths as long as the former, which has 35 rays. Squamation covering less than half of the trunk; ridge-scales coarsely serrated, each on the ventral aspect with about six points.

It seems probable that the so-called *Mesodon gibbosus* [1] is founded upon a small, distorted fish of this species. The original specimen is in the Palæontological Museum, Munich, and was obtained from the Lithographic Stone of Kelheim. Three other small fishes from Eichstädt, in the same Museum, also probably the young of *M. macropterus*, bear the name of *M. pulchellus* (A. Wagner, *loc. cit.* vol. ix. 1862, p. 351). Another dwarf variety, from the Middle Purbeck of Teffont, Wiltshire, is named *M. macropterus*, var. *parvus* (A. S. Woodward, Geol. Mag. [4] vol. ii. 1895, p. 147, pl. vii. fig. 2).

Form. & Loc. Lower Kimmeridgian (Lithographic Stone) : Bavaria.

P. 5546. Well-preserved fish 0·14 in length, shown of two-thirds the natural size in Pl. XVI. fig. 1 ; Eichstädt. As shown in side view, the basicranial axis is bent sharply downwards at the front of the orbit (*o.*) to the dentigerous vomer (*v.*); and some of the sutures in the cranial roof can be distinguished. The limits of the supraoccipital (*s.occ.*), squamosal (*sq.*), and parietal (*pa.*) plates are quite clear, and the latter element bears a large process (*x*) on its hinder margin, this directed backwards and subdivided into digitations at the extremity. The operculum (*op.*) and preoperculum (*p.op.*) are imperfect, but their relative proportions and characteristic radiating markings are seen. Some of the long hour-glass-shaped basals (*b.*) in the pectoral fin can also be observed. There are no scales on the caudal region, and the endoskeleton is thus well exposed. *By exchange*, 1888.

[1] A. Wagner, Abk. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. (1851), pp. 52, 56, pl. iii. fig. 2. *Gyrodus gibbosus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 236 (name only, *ex* Münster, MS.). A distorted specimen of *Mesodon* from the Lithographic Stone of Cirin, Ain, France, is also described under the same specific name by V. Thiollière, Poiss. Foss. Bugey, pt. ii. (1873), p. 13, pl. ii. fig. 12.

Mesodon gibbosus, E. Hennig, Centralbl. f. Min. 1907, p. 366, Text-figs. 4, 5.

Mesodon sayanus. See opposite p. 198.

P. 5546 has 39 supports in dorsal fin, 31 supports in anal fin.

Eomesodon gibbosus, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 54., P. de Saint-Seine 1949 N. Arch. Mus. N.H. Lyon 2 p. 130 ff. 56-58 pl. XIV f. A.

37107 Len. 35 supports in dorsal fin, about 29 in anal fin

1918. *Mesodon daviesi*, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 50, pl. xii. f. 1, 2.

41387, P. 6381. Des? & fig? A.S.W. *loc. cit.* 1918, p. 50, pl. xii. fig. 1.

37109. Imperfectly preserved similar fish, the head in counterpart and displaying part of the left splenial dentition; Solenhofen. There are traces of the tubercular ornament on the scales, and the serration of the ventral ridge-scales is conspicuous. *Häberlein Coll.*

P. 1628. Portion of caudal region of a somewhat larger fish; Kelheim. *Egerton Coll.*

37107. Small, nearly complete specimen, 0·07 in length, in counterpart; Solenhofen. The premaxillæ are shown, and the course of the dorsal "lateral line" is conspicuous on the squamation to the origin of the dorsal fin. *Häberlein Coll.*

Mesodon daviesi, A. S. Woodward.

1890. *Mesodon daviesi*, A. S. Woodward, Proc. Zool. Soc. 1890, p. 351, pl. xxviii. fig. 5.

Type. Nearly complete fish; British Museum.

A species attaining a length of about 0·25. Maximum depth of the trunk somewhat less than the length of the head and trunk without caudal fin; distance from frontal angulation to hinder margin of preoperculum scarcely exceeding one-fifth of the total length of the fish. [Dentition imperfectly known, but] teeth smooth, some indented, and those of the principal mandibular series at least twice as broad as long. Dorsal and anal fins equally elevated, the latter with 29 rays and four-fifths as long as the former, which has 38 rays. Squamation not covering more than half of the trunk.

Form. & Loc. Purbeckian: Dorsetshire.

41387, P. 6381. Type specimen, with incomplete counterpart; Purbeck Beds, Swanage. *Purchased*, 1869, *and Beckles Coll.*

P. 7454. Remains of head and abdominal region, doubtfully of th species; Swanage. The principal teeth of the mandible are more transversely elongated than those in the type specimen. *History unknown.*

P. 6383. Portion of caudal region of small fish, probably young of this species; Swanage. *Beckles Coll.*

The following specimen agrees with the type of *Mesodon daviesi* in the form and proportions of the trunk, but the head is relatively as long as in *Mesodon macropterus*. The difference is probably due to crushing.

P. 4381. Nearly complete fish 0·13 in length, wanting the paired fins; Purbeck Beds, Swanage. *Enniskillen Coll.*

Mesodon simus, Sauvage.

1893. *Mesodon simus,* H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. p. 441.

Type. Nearly complete fish.

A species described by Sauvage as closely resembling *M. daviesi*, but differing in the somewhat more elongated form of its trunk.

Form. & Loc. Lower Kimmeridgian: Orbagnoux, Ain, France.

Not represented in the Collection.

Mesodon comosus, Thiollière.

1858. *Mesodon comosus,* V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. p. 783 (name only).

1873. *Mesodon comosus,* P. Gervais, in V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 13, pl. ii. fig. 1.

Type. Fish, wanting head; Lyons Museum.

A species as large as *M. daviesi*, distinguished from all known forms by its remarkably short and deep dorsal and anal fins. Dorsal fin with about 27, anal fin with not less than 22 rays. Squamation covering much more than half of the trunk.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Cirin, Ain, France.

Not represented in the Collection.

Mesodon liassicus (Egerton).

1854. *Pycnodus liassicus,* Sir P. Egerton, Ann. Mag. Nat. Hist. [2] vol. xiii. p. 436.

1855. *Pycnodus liassicus,* Sir P. Egerton, Figs. & Descript. Brit. Organic Remains (Mem. Geol. Surv.), dec. viii. no. 10, pl. x.

1856. *Mesodon liassicus,* J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 202.

Type. Imperfect fish; British Museum.

An imperfectly known small species, about 0·13 in length. Maximum depth of the trunk less than the length of the head and trunk without caudal fin. Teeth smooth. Ornamentation of scales and external bones consisting of closely arranged, large, flattened tubercles.

Form. & Loc. Lower Lias: Leicestershire, Somersetshire, and Gloucestershire, France

19864. Type specimen; Barrow-on-Soar, Leicestershire.
Purchased, 1846.

P. 4381. Des? & fig? as M. daviesi in A.S.W. loc. cit. 1918, p. 51, pl. xii. fig. 2.

1949. Macromesodon comosus P. de St. Seine N. Archiv. Mus. N.H. Lyon 2 p. 110 Tf. 40 pl. viii

Eomesodon, A.S. Woodw.
[Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 54.]

1918. Eomesodon liassicus, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 54, text-fig. 21.
1949. E. L. P. de Saint-Seine C.R.S. Soc. geol. France 14 p. 324, 1 fig

~~[illegible]~~

Specimen of M. liassicus given by W. S. Symonds to Worcester Museum, & labelled "Bushley," is counterpart of P. 1336. Borrowed & compared this fossil, May 1917. A.S.W.

1986 4. Des? & fig? A.S.W. 1918, p. 54, text-fig. 21.

P. 1336. Noticed A. S. W. 1918, p. 55.

1918. Zonesodon rugulosus, A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 54.

(?) 1911. Mesodon aff. rugulosus, F. Priem, Ann. Paléont. vol. vi. p. 4, pl. iii. fig. 18. [Splenial from U. Sequanian of Bellême, Orne.]

1922. Mesodon rugulosus, G. D'Erasmo, Catal. Pesci Fos. d. Tre Venezie (Mem. Ist. Geol. R. Univ. Padova, vol. vi.), p. 53, pl. vi. figs. 7, 8.

P. 1336. Smaller imperfect head and trunk, wanting the greater part of the fins; Tarnhill, Tewkesbury, Gloucestershire. *Egerton Coll.*

P. 5127. Very small imperfect trunk, with abraded scales showing the tubercular ornament in part; Langport, Somersetshire. *Purchased*, 1886.

Mesodon rugulosus (Agassiz).

1825. Figure by C. Prevost, Ann. Sci. Nat. vol. iv. pl. xviii. fig. 18.
1837. *Pycnodus trigonus*, W. Buckland, Geol. & Mineral., ed. 2, vol. ii. p. 45, pl. xxvii. *c.* fig. 3.
1839–44. *Pycnodus rugulosus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 194, pl. lxxii. *a.* fig. 23.
1839–44. *Gyrodus trigonus*, L. Agassiz, *ibid.* p. 232, pl. lxix. *a.* fig. 15. [Vomer; British Museum][1].
1840. *Pycnodus rugulosus*, R. Owen, Odontography, pl. xxxiv. fig. 1.
1844. *Microdon trigonus*, L. Agassiz, Tableau Gén. Poiss. Foss. p. xlii. (name only).
1844. *Pycnodus parvus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 199 (name only). [Mandibular dentition; British Museum.]
1844. *Pycnodus trigonus*, L. Agassiz, *ibid.* p. 199 (name only).
1844. *Pycnodus latirostris*, L. Agassiz, *ibid.* p. 199. [Mandibular dentition; British Museum.]
(?) 1871. *Pycnodus rugulosus*, J. Phillips, Geol. Oxford, p. 179, woodc. xxxix. fig. 1.
1871. *Gyrodus trigonus*, J. Phillips, *ibid.* p. 179, woodc. xxxix. fig. 7.
1889. *Mesodon rugulosus*, A. S. Woodward, Geol. Mag. [3] vol. vi. p. 454.
1889. *Mesodon trigonus*, A. S. Woodward, *ibid.* p. 454.
1890–92. *Mesodon rugulosus*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 298, pl. iii. figs. 23–27, and *ibid.* vol. xii. p. 239, pl. iv. figs. 2–4.

Type. Vomerine dentition; Oxford Museum.

A species of large size, known only by the head. External bones ornamented with coarse granulations, closely arranged; maximum width of preoperculum exceeding half its depth. Teeth ornamented with a feeble rugosity radiating from an annular apical indentation, soon removed by abrasion; outline of teeth usually regularly rounded. Vomerine teeth closely arranged, those of the median series considerably broader than long and their breadth about equal to that of the two lateral series; an incomplete supplementary

[1] A vomer from the Bathonian of Pernigotti, Verona (de Zigno Collection, University of Padua), is also recorded under this name by F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxviii. (1885), p. 161.

series of small teeth occurring on each side. Splenial teeth closely arranged, those of the principal series considerably broader than long, flanked within by one irregular row of small round teeth and externally by three series, of which the outermost scarcely exceeds the innermost in size.

Form. & Loc. Bathonian: Northamptonshire, Oxfordshire, and Gloucestershire; Normandy [1].

38554. Imperfect large vomer; locality unknown.
Purchased, 1864.

42274. Smaller vomerine dentition, less abraded; locality unknown.
Baugh Coll.

35498. Vomerine dentition 0·02 in length; Stonesfield Slate, Stonesfield. *Purchased*, 1860.

P. 1648–a. Similar specimen and one smaller; Stonesfield.
Egerton Coll.

32550. Plaster cast of imperfect vomerine dentition; Great Oolite, Caen, Normandy. *Tesson Coll.*

P. 3779. Small vomerine dentition described and figured by Agassiz, *loc. cit.*, as the type specimen of *Gyrodus trigonus*; Stonesfield. *Enniskillen Coll.*

P. 521. Smaller specimen noticed by Agassiz, *loc. cit.*, and figured in Proc. Geol. Assoc. vol. xi. (1890), pl. iii. fig. 26; Stonesfield. *Egerton Coll.*

P. 4387. Right splenial dentition, much broken; Stonesfield.
Enniskillen Coll.

1370 (Sloane Catalogue). Smaller specimen, right side; Witney, Oxfordshire. *Sloane Coll.*

P. 1666 c. Smaller right splenial; Stonesfield. *Egerton Coll.*

P. 522. Small right splenial dentition, labelled "*Pycnodus parvus*, Ag.," in Agassiz' handwriting, described and figured in Proc. Geol. Assoc. vol. xi. (1890), p. 299, pl. iii. fig. 23; Stonesfield. *Egerton Coll.*

P. 3780–81. Slightly larger examples of the right and left splenial dentition, the first labelled "*Pycnodus latirostris*, Agass.,"

[1] A very similar though not identical dentition is also known from the Kimmeridgian of Hanover (K. Fricke, Palæontogr. vol. xxii. 1875, p. 362, pl. xix. figs. 6, 7).

Tomesodon barnesi, A. S. W.

1906. Mesodon barnesi, A. S. Woodward, Proc. Druce Field Club, vol. xxvii. p. 187, pl. B, figs. 1–4.

1918. Tomesodon barnesi, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 56, pl. xiii. f. 1, text-fig. 22.

Type. Imperfect fish; F. J. Barnes Coll.

Form. & Loc. Portlandian: Portland. M. Purbeckian: Swanage.

P. 6382. Fragmentary fish des? & fig? loc. cit. 1918, p. 57, pl. xiii. fig. 1; M. Purbeck Beds, Swanage. Beckles Coll.

Tomesodon depressus, A. S. W.

1918. Tomesodon depressus, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 57, pl. xiii. fig. 2.

Type. Wing portion of fish; British Museum.

Form. & Loc. M. Purbeckian: Swanage.

P. 10583. Type specimen des? & fig? loc. cit. 1918; Swanage. Pres? by F. Horenden, Esq., 1908.

1922. Mesodon buckslandi, G. D'Erasmo, Catal. Pesci Foss. d. Tre Venezie (Mem. Ist. Geol. R. Univ. Padova, vol. vi.), p. 52, pl. vi. figs. 2–5.
1930, M. D: Thomaset° fig. 47. (Strachan Gleich).

in Agassiz' handwriting, described and figured in Proc. Geol. Assoc. vol. xi. (1890), p. 299, pl. iii. fig. 27 ; Stonesfield. *Enniskillen Coll.*

P. 1666. Similar splenial dentition of left side ; Stonesfield. *Egerton Coll.*

P. 3734. Four more imperfect small examples of the splenial dentition ; Stonesfield. *Enniskillen Coll.*

Mesodon bucklandi (Agassiz).

1833–44. *Pycnodus bucklandi*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 16, pt. ii. p. 192, pl. lxxii. *a*. fig. 15 (*non* figs. 16–22).
1839–44. *Pycnodus didymus*, L. Agassiz, *ibid.* p. 193, pl. lxxii. *a*. figs. 24, 25. [Mandibular dentition ; British Museum.]
1839–44. *Pycnodus ovalis*, L. Agassiz, *ibid.* p. 195, pl. lxxii. *a*. fig. 5. [Vomerine dentition ; Bristol Museum.]
1840. *Pycnodus bucklandi*, R. Owen, Odontogr. pl. xxxiv. fig. 2.
1840. *Pycnodus didymus*, R. Owen, *ibid.* pl. xxxiv. fig. 3.
1844. *Pycnodus obtusus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 199 (name only). [Vomer ; British Museum.]
1871. *Pycnodus bucklandi*, J. Phillips, Geol. Oxford, p. 179, woodc. xxxix. figs. 4, 5.
1871. *Pycnodus didymus*, J. Phillips, *ibid.* p. 179, woodc. xxxix. fig. 6.
1885. *Mesodon bucklandi*, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxviii. p. 160.
1889. *Mesodon bucklandi*, A. S. Woodward, Geol. Mag. [3] vol. vi. p. 454.
1890. *Mesodon bucklandi*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 297, pl. iii. figs. 20–22.

Type. Vomerine dentition ; Oxford Museum.

In Inst. Geol. Univ. Neuchâtel acc. to A. Jeannet-1928, Bull. Soc. neuchâtel. Sci. nat. LII p. 110.

A species of large size, known only by the dentition. Teeth smooth, often irregular in outline, the rounded contour being frequently interrupted by angulations. Vomerine teeth well spaced ; those of the median series, except quite anteriorly, less than twice as broad as long, but their breadth exceeding that of the two lateral series ; teeth of the inner lateral series much larger than those of the outer series, not regularly alternating ; a few small scattered teeth also occurring irregularly between the median and inner lateral series. Splenial teeth well spaced, those of the principal series almost twice as broad as long, flanked within by a single row of small rounded teeth and externally by three regular series, of which the second only equals the innermost row in size, while the first is slightly larger, and the third (or outermost) much larger than all except the principal series.

Form. & Loc. Bathonian: Oxfordshire, Wiltshire, and Northamptonshire; (?) S. Bartolomeo, Verona, Italy.

P. 1640. Vomerine dentition figured in Proc. Geol. Assoc. vol. xi. pl. iii. fig. 20; Stonesfield Slate, Stonesfield. *Egerton Coll.*

P. 1646. More imperfect large specimen; Stonesfield. *Egerton Coll*

P. 525. Fragment of similar dentition, the undescribed type specimen of *Pycnodus obtusus*, Agassiz, figured in Proc. Geol. Assoc. vol. xi. pl. iii. fig. 22; Stonesfield. *Egerton Coll.*

P. 3739. Portion of smaller vomerine dentition; Forest Marble, Atford, near Bath. *Enniskillen Coll.*

P. 1647. Portion of still smaller specimen; Stonesfield. *Egerton Coll.*

39776. Small vomerine dentition, the teeth more closely arranged than usual; Stonesfield. *Purchased*, 1862.

47982. Vomerine dentition 0·018 in length; Stonesfield. *Presented by the Hon. Robert Marsham*, 1877.

P. 3733. Smaller specimen; Stonesfield. *Enniskillen Coll.*

P. 3732. Left splenial dentition, the type specimen of *Pycnodus didymus*, described and figured by Agassiz, *loc. cit.*; Stonesfield. *Enniskillen Coll.*

P. 3736. Similar specimen, fractured and in counterpart; Stonesfield. *Enniskillen Coll.*

P. 1641. Slightly smaller right splenial dentition, showing only the bases of the teeth; Stonesfield. *Egerton Coll.*

P. 1649, P. 1666 a, b. Five small examples of the splenial dentition, one in counterpart; Stonesfield. *Egerton Coll.*

P. 1652. Imperfect left splenial dentition apparently of this species, labelled "*Pycnodus Hugii*, Ag.," by Agassiz; Stonesfield. *Egerton Coll.*

The following scales are referable either to this or to the preceding species:—

P. 520, P. 3776–77. Type specimens of the so-called *Gyrodus perlatus*, Agassiz (Poiss. Foss. vol. ii. pt. ii. 1844, p. 236),

being four scales, of which the first two are described and figured by the present writer in Proc. Geol. Assoc. vol. ix. (1890), p. 297, pl. iii. figs. 30, 31; Stonesfield Slate, Stonesfield. *Egerton & Enniskillen Colls.*

Mesodon tenuidens, A. S. Woodward.

1890. *Mesodon tenuidens*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 300, pl. iii. fig. 29 (erroneously named *latidens* in text).

Type. Right splenial dentition; British Museum.

A small species known only by the splenial dentition. Teeth finely rugose, with a transversely elongated apical pit; all or nearly all the teeth broader than long. Principal teeth on splenial bone at least twice as broad as long, arched, and inwardly tapering; this series flanked within by one row, and externally by four rows of small teeth passing forwards into two rows.

Form. & Loc. Bathonian: Oxfordshire.

47983. Type specimen; Stonesfield Slate, Stonesfield.
Presented by the Hon. Robert Marsham, 1877.

Mesodon lævior, Fricke.

1846. *Pycnodus didymus*, G. von Münster (*errore*), Beitr. Petrefakt. pt. vii. p. 41, pl. ii. fig. 26, pl. iii. fig. 6.

(?) 1864. *Pycnodus hugii*, H. Credner (*errore*), Zeitschr. deutsch. geol. Ges. vol. xvi. p. 244, pl. xi. fig. 7.

1875. *Mesodon lævior*, K. Fricke, Palæontogr. vol. xxii. p. 364, pl. xix. figs. 9–12, pl. xx. figs. 1, 2.

Type. Splenial dentition.

A species of moderate or large size, known only by the dentition. Teeth irregularly rounded in outline, with an apical pit very shallow in the principal series, and with feeble radiating rugæ. Vomerine teeth closely arranged; those of the median series not much broader than long, and their breadth about equalling that of the two lateral series; outer lateral series scarcely smaller than the inner, and often flanked by an incomplete supplementary row of minute teeth. Teeth of principal series on splenial bone much broader than long and inwardly tapering; flanked within by one continuous and one incomplete series of small teeth; and flanked externally by three series, of which the inner equals the outer in size, and the median is sometimes in part duplicated.

Form. & Loc. Upper Corallian and Kimmeridgian: Hanover.[1]

[1] The fragments from the Kimmeridgian and Portlandian of N. France ascribed to this species by Sauvage (Bull. Soc. Géol. France, [3] vol. viii. 1880, p. 529, pl. xix. fig. 4) appear to be incorrectly determined. = Mesodon aff. granulatus, H. E. Sauvage, B. S. G. F. [4] vol. i (1901), p. 548.

P. 3749. Vomerine dentition with comparatively narrow median teeth; Coral Rag, Lindnerberg, Hanover.

Enniskillen Coll.

P. 5950. Vomer, partly fractured, showing some of the unworn rugose teeth; Coral Rag, Holzen, Eschershausen.

Purchased, 1889.

P. 7438. Fragments of two large vomers; Kimmeridgian, Langenberg. *Purchased*, 1895.

P. 5951. Right splenial; Holzen. *Purchased*, 1889.

P. 7436. Associated splenials; Langenberg. *Purchased*, 1895.

Mesodon granulatus (Münster).

1846. *Pycnodus granulatus*, G. von Münster, Beitr. Petrefakt. pt. vii. p. 44, pl. iii. figs. 11, 12.

1846. *Pycnodus jugleri*, G. von Münster, *ibid.* p. 42, pl. iii. figs. 8-10. [Fragments of dentition; Palæontological Museum, Munich.]

(?) 1846. *Pycnodus nicoleti*, G. von Münster (*errore*), *ibid.* p. 42.

1858. *Pyknodus granulatus*, F. A. Quenstedt, Der Jura, p. 782, pl. xcvi. fig. 20.

1875. *Mesodon granulatus*, K. Fricke, Palæontogr. vol. xxii. p. 359, pl. xviii., pl. xix. figs. 1–5.

(?) 1880. *Mesodon granulatus*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. p. 528, pl. xix. fig. 3. See p. 214 MS. below. = M. rigauxi.

Type. Detached teeth; Natural History Museum, Berlin.

A large species, imperfectly known. External bones and scales ornamented with very coarse granulations. Teeth feebly rugose, those of the lateral series with an apical pit, and soon becoming smooth by abrasion; outline of teeth often irregularly rounded. Vomerine teeth sparsely arranged, those of the median series considerably broader than long, and their breadth equalling or slightly exceeding that of the two lateral series. Splenial teeth more closely arranged, those of the principal series often twice as broad as long, flanked within by one row of small round teeth and externally by three series, of which the median is the smallest (sometimes partly duplicated) and the outer about equal in size to the inner series.

This definition is based upon the researches of Fricke.

Form. & Loc. Corallian and Kimmeridgian: Hanover, Würtemberg, S. England, and (?) N. France. Portugal?

P. 1655. Portion of left splenial dentition; Corallian, Lindnerberg, Hanover. *Egerton Coll.*

1858. M. J. N. Sauvage, Ver. Foss. Perche 2. 15 pl. 1. f. 7.

1906. Mesodon granulatus, A. S. Woodward, Proc. Dorset Nat. Field Club, vol. xxvii, p. 187, pl. B, fig. 6.

? 1906. Mesodon granulatus, E. Hennig, Palaeontogr. vol. 7iii. p. 189, text-fig. 13.

1918. Eomesodon granulatus, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 54.

P. 3786 2. fig. by A.S.W., Proc. Dorset Field Club, vol. xxvii (1906), pl. B, fig. 6.

P. 5102. More nearly complete specimen; Lindnerberg.
Presented by J. E. Lee, Esq., 1885.

28506. Portion of left splenial dentition; Coral Rag, Schnaitheim, Würtemberg. *Purchased*, 1847.

40636. Right splenial bone with much-worn teeth, doubtfully assigned to this species; Coral Rag, Weymouth.
Purchased, 1867.

P. 3786 d. Small right splenial closely resembling the specimen figured by Fricke, *loc. cit.* pl. xix. fig. 3; Kimmeridge Clay, Weymouth. *Enniskillen Coll.*

P. 6748. Abraded portion of similar left splenial; Kimmeridge Clay, Weymouth. *Purchased*, 1892.

P. 3741. Portion of small right splenial dentition; probably from the Coral Rag of Weymouth. *Enniskillen Coll.*

Mesodon nicoleti (Agassiz).

1844. *Pycnodus nicoleti*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 192, pl. lxxi. fig. 14.
1860. *Pycnodus nicoleti*, F. J. Pictet, Rept. & Poiss. Foss. Jura Neuchâtelois, p. 55, pl. xiii. figs. 1–3.
1879. *Pycnodus nicoleti*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. p. 33, pl. ii. fig. 6.

Type. Imperfect splenial dentition.

A large species, known only by the dentition of the lower jaw, which appears to differ from that of *M. granulatus* merely in the greater length of the principal teeth as compared with their breadth. Future discoveries must determine whether the two supposed species are truly distinct.

None of the specimens in the Collection show more than one inner series and three outer series of small teeth on the splenial bone.

Form. & Loc. Kimmeridgian: Switzerland; Yonne, France, (?) Portlandian: Germany.

P. 1644. Imperfect left splenial dentition, much worn; Soleure.
Egerton Coll.

P. 3740. Two similar specimens; Soleure. *Enniskillen Coll.*

P. 5292. Portion of left splenial dentition, showing the rugosity on one of the principal teeth; Soleure.
Presented by Her Grace the Duchess of St. Albans, 1876.

P. 7437. Left splenial either of this or the preceding species; Portlandian (zone of *Ammonites gigas*), Duingen, Harz. *Purchased*, 1895.

Mesodon damoni, A. S. Woodward.

1860. *Pycnodus bucklandi*, R. Damon (*errore*), Geol. Weymouth, Suppl. pl. viii. fig. 9.
1890. *Mesodon*, sp., Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 121.
1890. *Mesodon damoni*, A. S. Woodward, Geol. Mag. [3] vol. vii. p. 158.
1893. *Mesodon damoni*, A. S. Woodward, *ibid.* vol. x. pl. xvi. fig. 6.

Type. Left splenial dentition; British Museum.

A large species, known only by the dentition of the lower jaw. Teeth rounded or closely arranged, smooth or very feebly rugose, without an apical pit. Teeth of principal series on splenial bone almost or quite twice as broad as long; teeth of the inner series considerably larger than any of the outer series, flanked within also by an irregular, incomplete row of small teeth; those of the outer series arranged in four irregular rows, variable in size, but the innermost and outermost usually the largest.

Form. & Loc. Portlandian: Dorsetshire.

P. 6165. Left splenial bone, the type specimen; Portland. *Damon Coll.*

P. 6180. Right and left splenial dentition, partly fractured, in slab of limestone; Upway, near Weymouth. *Damon Coll.*

P. 1642–3. Imperfect right and left splenials; near Weymouth. *Egerton Coll.*

P. 3738. Right splenial; near Weymouth. *Enniskillen Coll.*

P. 4678. Fragmentary left splenial; Ridgway near Weymouth. *Presented by C. Westendarp, Esq.*, 1884.

Mesodon gigas (Agassiz).

1742. Dent de *Dentato*, L. Bourguet, Traité des Pétrifications, p. 78, pl. lvii. fig. 396.
1833–44. *Pycnodus gigas*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17, pt. ii. p. 191, pl. lxxi. fig. 13, pl. lxxii. *a*. figs. 56–58.
1839. *Pycnodus gigas*, F. A. Roemer, Verstein. Norddeutsch. Oolithengeb., Nachtr. p. 54.
1860. *Pycnodus gigas*, F. J. Pictet, Rept. & Poiss. Foss. Jura Neuchâtelois, p. 46, pls. x., xi., pl. xviii. fig. 2.

1906. Mesodon damoni, A.S. Woodward, Proc Dorset Nat. Field Club, vol. xxvii, p. 186, pl. B, fig. 5.

1930. M. d. ? Thurnaset°, Figs. 33, 49 (skeletal fragments).

P.7509. Left splenial, fig.? by A.S.W., Proc. Dorset Field Club, vol. xxvii (1906), pl B, fig. 5; Portland. Purchased, 1895.

1938. Pycnodus gigas. Gustavsson° p. 29 & 22. (skeletal fragments).

1901. Mesodon affinis, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i. p. 545; pl. xii. fig. 6.

[?]1911. Mesodon cf. affinis, F. Priem, Ann. Paléont. vol. vi. p. 4, pl. iii. fig. 17. [Separial from U. Bathonian, Ranville, Calvados.]

Mesodon cf. pipas, M. Leriche, Bull. Soc. Géol. France [4] vol. x (1910), p. 464, text-fig. 1. [J or M; U. Neocomian, Brillon, Meuse.]

Type. Portions of splenial dentition; Stuttgart Museum.

The largest species hitherto discovered, known only by the splenial dentition. Teeth rounded and closely arranged, smooth or feebly rugose, with traces of a shallow apical pit only in the lateral series. Teeth of principal series at least twice as broad as long, scarcely if at all arched, and almost equally blunt at each extremity; inner series very small and irregular; outer teeth in four irregular series, largest and broader than long or reniform in the innermost of these, smallest in the second and third series, which are especially irregular.

Form. & Loc. Kimmeridgian: Switzerland; N. Germany [1].

P. 3742. Imperfect right splenial bone, with teeth of principal and first outer series; Neuchâtel. *Enniskillen Coll.*

P. 3743. Plaster cast of a nearly similar specimen, left side; Soleure. *Enniskillen Coll.*

28379. Imperfect right splenial dentition, of small size, doubtfully referable to young of this species; Soleure. The principal teeth are more arcuated than usual and nearly three times as broad as long; the inner teeth are minute; the second outer series of teeth is relatively larger than in the typical adult dentition. *Purchased*, 1853.

P. 7440. Imperfect left splenial, with remains of dentary externally ornamented with fine tubercles; Langenberg, Hanover. *Purchased*, 1895.

Mesodon affinis (Pictet).

1860. *Pycnodus affinis*, F. J. Pictet (*ex* Nicolet, MS.), Rept. & Poiss. Foss. Jura Neuchâtelois, p. 50, pls. xii., xii. *bis*, pl. xix. fig. 1.

Type. Splenial dentition; Neuchâtel Museum.

A species somewhat smaller than *M. gigas*, also known only by the mandibular dentition, which closely resembles that of the last-named species, differing (1) in the relatively larger size of the inner series of teeth, which is sometimes duplicated, and (2) in the relatively smaller size and rounded form of the teeth in the innermost of the outer series.

Form. & Loc. Kimmeridgian: Switzerland. also Boulogne.

[1] Detached teeth from the Kimmeridgian and Portlandian of Boulogne have also been assigned to this species by H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (1867), p. 25; others from the Diceraskalk of Kelheim, Bavaria, by M. Schlosser, Palæontogr. vol. xxviii. (1881), p. 58, pl. viii. figs. 4, 5; others from the Tithonian of Verona, by F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxviii. (1885), p. 158, pl. ii. *a*. figs. 10, 11.

P. 3745. Fragmentary right splenial bone; Soleure.
Enniskillen Coll.

The following portions of dentition appear to belong to the genus *Mesodon*, but are specifically undetermined:—

1370 a (Sloane Catalogue). Fragment of splenial dentition; Great Oolite, Witney, Oxfordshire. *Sloane Coll.*

P. 3737. Fragment of splenial labelled "Gt. Oolite, Gibraltar, near Oxford," but much resembling the Portlandian *Mesodon damoni*. *Enniskillen Coll.*

36141. Imperfect left splenial; Forest Marble, Atford, near Bath.
Purchased, 1859.

36145. Well-preserved left splenial dentition, with only two complete outer series of teeth; Forest Marble, Stanton, Gloucestershire. *Cunnington Coll.*

46338. Imperfect left splenial with very smooth teeth; Forest Marble, Atford, near Bath. *Cunnington Coll.*

47139. Portion of small vomerine dentition; Great Oolite, Buttock's Booth, Northampton. *Sharp Coll.*

40353. Fine vomer with remarkably rounded teeth, the inner lateral series comparatively small and with minute intercalary teeth (Pl. XVII. fig. 1); Great Oolite, Caen, Normandy. *Purchased*, 1867.

22659. Portion of large right splenial dentition; Coral Rag, Schnaitheim, Würtemberg. *Purchased*, 1848.

41869. Imperfect vomer with well-spaced teeth, those of the median series not much wider than long; Kimmeridge Clay, Weymouth. *Purchased*, 1869.

P. 6169. Imperfect left splenial, figured by R. Damon, Geol. Weymouth, ed. 2 (1880), Suppl. pl. ix. fig. 11; Kimmeridge Clay, Weymouth. *Damon Coll.*

P. 4391. Portion of small splenial; Kimmeridgian, Soleure, Switzerland. *Enniskillen Coll.*

30870. Portion of vomer with closely arranged teeth, those of the median series nearly twice as broad as long; Portland Stone, Ridgway, near Weymouth. *Purchased*, 1856.

21349. Left splenial dentition, with principal teeth much elongated transversely; Purbeck Beds, Swanage. *Purchased*, 1847.

In the Exeter Museum there is a vomerine dentition of *Mesodon* from the Portlandian of Hartwell, Bucks, identical with that from Portland with 7 rows of teeth.

H.A.B. May 14. 1907.

P. 3757 is des? & fig? A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 58, pl. xiii. fig. 3.

Mesodon barnesi, A.S. Woodward, Proc. Dorset Field Club, vol. xxvii (1906), p. 187, pl. B, figs. 1–4. — Portland Stone; Portland. [Fish; F.J. Barnes Coll.]

See p. 204.

Macromesodon bathonicus, J.F. Blake, Mon. Fauna Cornbrash (Pal. Soc. (1905), p. 32, pl. i. fig. 10.

Mesodon bouchardi, H.E. Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), p. 546, pl. xii. figs. 7, 8. — Kimmeridgian: N. France. [Portion of splenial; Havre Museum.]
= Uranoplosus bouchardi, H.E. Sauvage, l.c. p. 547.

Mesodon combesi, H.E. Sauvage, Mém. Soc. Géol. France, Paléont. no. 25 (1902), p. 13, pl. i. fig. 9, pl. ii. fig. 2. —
M. combesi, var. grezicus nov. Portland. Quarry G. Asha 1955 Bull. Soc. Hist. nat Toulouse 90 p. 327 1 fig. Homer.

Mesodon fourtaui, H.E. Sauvage,

P. 3757. Another specimen with more numerous flanking teeth; Purbeck Beds, Swanage. *Enniskillen Coll.*

35577. Portion of left splenial apparently of a large species of *Mesodon*, with numerous small lateral teeth; Lias, Camerton, near Bath. The bone measures about 0·025 in maximum width, and the teeth of the principal series are somewhat broader than long.

Presented by Hugh Owen, Esq., 1859.

The following species have also been founded on portions of dentition, of which there are no examples in the Collection:—

Mesodon autissiodorensis: *Pycnodus autissiodorensis*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 38, pl. i. fig. 6.—Neocomian; Yonne, France. [Right splenial.]

Mesodon bathonicus, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 527, pl. xix. fig. 1. *Pycnodus affinis*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (1867), p. 26, pl. ii. fig. 6 (*errore*).—Bathonian; Marquise. [Imperfect left splenial; Boulogne Museum.]

Mesodon boloniensis, H. E. Sauvage, *loc. cit.* (1880), p. 527. *Pycnodus boloniensis*, H. E. Sauvage, *op. cit.* (1867), p. 27, pl. ii. fig. 4. *Pycnodus jugleri*, H. E. Sauvage, *ibid.* (1867), p. 27, pl. ii. fig. 5 (*errore*).—Bathonian; Marquise. [Portion of right splenial; Boulogne Museum.]

Mesodon diastematicus, E. D. Cope, Journ. Acad. Nat. Sci. Philad. [2] vol. ix. (1894), p. 443, woodc. fig. 5.—Lower Cretaceous; Texas. [Vomer of uncertain genus.]

Mesodon dumblei, E. D. Cope, *ibid.* p. 444, pl. xx. fig. 7. *Microdus dumbelii*, E. D. Cope, Proc. Amer. Phil. Soc. vol. xxx. (1892), p. 128.—Lower Cretaceous; Texas [Left splenial.] ? = *Anomoeodus*" J. W. Gidley, Proc. U.S. Nat. Mus. vol. 46 (1913), p. 449. Copy Journ. Acad. Nat. Sci. Philad. [2] vol. 9 (1895), p. 444.

Mesodon dutertrei, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 528 (in part). *Pycnodus dutertrei*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (1867), p. 31, pl. ii. fig. 7 (*non* pp. 38, 45, pl. ii. figs. 8, 9 = vomer of *Gyrodus* and splenials of *Lepidotus*).—Portlandian; N. France. [Left splenial; Boulogne Museum.] *Gyrodus dutertrei*, H. E. Sauvage, B.S.G.F. [4] vol. i (1901), p. 544.

Mesodon gervaisi, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 527. *Pycnodus gervaisi*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (1867), p. 29, pl. ii. fig. 2, and Bull. Soc. Géol. France, [3] vol. viii. (1880),

p. 461, pl. xiv. figs. 2, 3.—Bathonian; Marquise. [Right splenial; Boulogne Museum.]

Mesodon heckeli, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1862), p. 345, pl. i. fig. 5.—Lower Kimmeridgian (Lithographic Stone); Solenhofen, Bavaria. [Imperfect dentition in fragmentary fish; Palæontological Museum, Munich.]

Mesodon morinicus, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 528, pl. xix. fig. 2;—Portlandian; N. France. [Portion of left splenial; School of Mines, Paris.]

Mesodon pusillus, K. Fricke, Palæontogr. vol. xxii. (1875), p. 367, pl. xix. fig. 14, pl. xx. figs. 3, 4.—Kimmeridgian; Hanover. [Upper and lower dentition.]

Mesodon radiatus: *Gyrodus radiatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 232, pl. lxix. *a*. fig. 20.—Bathonian; Caen, Normandy. [Vomer.]

Mesodon robustus: *Pycnodus robustus*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 159, pl. iii. fig. 22.—Neocomian; Saint Dizier, Creuse. [Portion of left splenial; Cornuel Collection.]

Mesodon sauvagei: *Pycnodus sauvagei*, F. J. Pictet, Mém. Soc. Linn. Normandie, vol. xvi. no. 1 (1872), p. 19, pl. i. fig. 5; J. Cornuel, Bull. Soc. Géol. France, [3] vol. xi. (1883) p. 18, pl. i. figs. 1–3.—Portlandian; Haute Marne. [Vomer; Royer Coll.]

An undescribed right splenial of *Mesodon*, with very irregular teeth, from the Jurassic of Mejdel Shems, near Cæsarea Philippi, is preserved in the Museum of the Syrian Protestant College, Beyrout.

Indeterminable detached teeth and miscellaneous portions of jaws with widely spaced teeth, apparently of *Mesodon*, are recorded from the Neocomian of Europe under the name of *Pycnodus couloni*; but the specific characters even of the dentition are not as yet defined. The name has been given to detached teeth from Neuchâtel (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 200, and P. de Loriol & V. Gilliéron, Mém. Soc. Helvét. Sci. Nat. vol. xxiii. 1869, no. 5, p. 5, pl. i. figs. 5–7); detached teeth from Sainte Croix, Switzerland, and Dept. Ain, France, and an imperfect splenial from Auxerre, France (Pictet & Campiche, Foss. Terrain Crét. St. Croix, pt. i. 1860, p. 57, pl. vii. figs. 5–17, with reference to P. Gervais, Zool. et Pal. Franç. 1852, pl. lxix. fig. 22); other detached teeth from Piedmont (E. Sismonda, Mem. R. Accad. Sci. Torino, [2] vol. xix. 1861, p. 455, pl. i. figs. 1–11); an imperfect

Mesodon couloni Mesc. Ste. Hanes L. Hennger 1946.
Trav. Lab. Geol. Fac. Sci. Univ. Grenoble 25 p. 35 f. 4.

Mesodon matheroni, Priem. See p. 279 MS.

Mesodon lennieri, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), p. 546, pl. xii. fig. 9. — Kimmeridgian; N. France. [Portion of splenial; Havre Museum.]

Mesodon lingua, H. E. Sauvage,

M. linea s.n. H. E. Sauvage 1898 Ver. Foss. Port. 16 pl. 1 f. 9 Splenial U. Cret. Portugal

H. E. Sauvage, Op. cit. [4] vol. i (1901), p. 549, pl. xii. fig. 10.

Typodus valens, s.n. O. P. Hay. Univ. Texas Bull. 71, p. 5, pl. 1. f. 2. L. Cret. Texas. Vamer. Baylor Univ. Texas

M. sharpei s.n. H. E. Sauvage 1898 Ver. Foss. Port. 16 pl. 1 f. 8 Vamer. U. Cret. Portugal

Mesodon spinosum, E. Hennig, Centralbl. f. Min. &c 1907, p.

Mesodon simulans, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), p. 549, pl. xii. fig. 11. — L. Portlandian; Boulogne.

Mesodon sp., A. Bigot, Mém. Soc. Linn. Normandie, vol. xxi (1904), p. 95, pl. iv, fig. 11. — U. Jurassic; Cordebugle. [Splenial.]

Mesodon rigauxi, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), p. 548. Mes. granulatus, H. E. Sauvage (errore) B. S. G. F. [3] viii (1880), p. 528, pl. xix. f. 3. — U. Kimm.; Boulogne. [Splenial.] Also Portlandian.

Mesodon spinosus, E. Hennig, Centralbl. f. Min. 1907, p. 364, text-fig. 3. — U. Cretaceous; Bakel, Lebanon. [Imperfect fish; Berlin Museum f. Naturk.]

Mesodon hoeferi, D. G. Kramberger, Beitr. Paläont. u. und Geol. Oesterr.-Ungarns, vol. xviii (1905), p. 219, pl. xx, fig. 5; pl. xxi, fig. 2. — Upper Trias; Hallein, Salzburg.
Eomesodon hoeferi, A. S. Woodward, Ann. Fishes Wealden & Purb. Form. (Pal. Soc. 1916), 1918, p. 54.

splenial from Yonne, France (H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. 1879, p. 35, pl. ii. fig. 5); an imperfect splenial from the Lower Neocomian of Ville-sur-Saulx, Meuse, France (J. Cornuel, Bull. Soc. Géol. France, [3] vol. viii. 1880, p. 158, and *ibid.* [3] vol. xi. 1883, p. 24, pl. i. fig. 10); and fragments from the phosphates of Cambridgeshire and Bedfordshire (W. Keeping, Foss. Neocom. Upware, 1883, p. 82, pl. i. fig. 5).

To *Mesodon* may also probably be referred the portions of vomerine dentition from the Corallian of Schnaitheim, Würtemberg, described under the names of *Typodus annulatus* and *splendens* by F. A. Quenstedt, Der Jura (1858), p. 781, pl. xcvi. figs. 16–18. A fragment of a similar vomer is ascribed to *Sphærodus* by F. A. Quenstedt, Handb. Palæont. (1852) p. 214, pl. xvi. fig. 9.

The undefined name of *Pycnodus tristychius* (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 199) seems to have been given to an English Jurassic jaw of *Mesodon*, probably from the Stonesfield Slate. The type specimen was originally in the Bristol Museum.

The following form of dentition seems to be related to *Mesodon*, but is not represented in the Collection :—

Gyronchus oblongus, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844) p. 202, pl. lx. *a*, figs. 10, 11. *Gyronchus* (*Scaphodus*) *oblongus*, L. Agassiz, *ibid.* vol. i. (1844), p. xlii. *Scaphodus heteromorphus*, J. Morris ("*ex* Agassiz, MS."), Catal. Brit. Foss. (1854), p. 344; A. S. Woodward, Proc. Geol. Assoc. vol. xi. (1890), p. 301, pl. iii. figs. 33, 34. *Mesodon oblongus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata (1890), p. 120.—Stonesfield Slate; Stonesfield. [Vomer; Bristol Museum.]

Genus **ATHRODON,** Sauvage.

[Bull. Soc. Géol. France, [3] vol. viii. 1880, p. 530.]

An imperfectly definable genus, known only by the splenial bone, which much resembles that of *Mesodon*, but is considerably stouter and exhibits a remarkably deep symphysial facette. Splenial teeth as in *Mesodon*, but usually much more irregularly arranged, and the principal longitudinal series not well differentiated.

Athrodon douvillei, Sauvage.

1880. *Athrodon douvillei*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. p. 530, pl. xix. fig. 5.

Type. Left splenial; School of Mines, Paris.

The type species. Splenial bone longer than broad, with very

small, widely spaced teeth, mostly circular and conspicuously mammillated, disposed in from 7 to 10 irregular longitudinal series, somewhat enlarged towards the symphysial margin of the bone.

The dentition of the type specimen measures 0·019 in maximum width and 0·045 in length.

Form. & Loc. Lower Portlandian: Boulogne.

Not represented in the Collection.

Athrodon intermedius, A. S. Woodward.

1893. *Athrodon intermedius,* A. S. Woodward, Geol. Mag. [3] vol. x. p. 434, pl. xvi. fig. 1.

Type. Left splenial dentition; British Museum.

Splenial bone comparatively elongated, with large, closely arranged teeth, mostly smooth and nearly circular, a few exhibiting an apical pit with feebly crimped margin, disposed in about 5 or 6 irregular longitudinal series, the largest forming a principal series near the symphysial margin of the bone.

Form. & Loc. Purbeckian: Aylesbury, Buckinghamshire.

40314. The type specimen, described and figured *loc. cit.* The dentition measures 0·017 in maximum width and 0·03 in length. *Purchased,* 1867.

Athrodon crassus, A. S. Woodward.

1893. *Athrodon crassus,* A. S. Woodward, Geol. Mag. [3] vol. x. p. 435, pl. xvi. fig. 3.

Type. Right splenial with abraded dentition; Woodwardian Museum, Cambridge.

Splenial bone short and broad, with large, widely-spaced teeth, mostly circular, disposed in about four irregular longitudinal series, largest near the middle of the bone.

The dentition of the type specimen measures 0·02 in maximum width and 0·04 in length.

Form. & Loc. Cenomanian: Cambridge.

Not represented in the Collection.

Athrodon jessoni, A. S. Woodward.

1895. *Athrodon jessoni,* A. S. Woodward, Geol. Mag. [4] vol. ii. p. 208. pl. viii. fig. 1.

Type. Right splenial; British Museum.

Splenial bone very robust, but narrower than in *A. crassus,* with

1916. *Athrodon intermedius*, A. S. Woodward, Trans. Fisher Weald. & Purb. Form. (Pal. Soc. 1915), p. 48, text-fig. 19.

40314 desc. & fig.: A. S. W. loc. cit. 1916.

Athrodon sp., F. Priem, Ann. Paléont. vol. vi (1911), p. 18, pl. iii. fig. 21. — L. Senonian; S. Paterne, Indre-et-Loire.

large, closely-arranged teeth, mostly circular, all smooth, disposed in three nearly regular longitudinal series. Anteriorly the three series are about equal in size; posteriorly the median teeth are slightly the larger.

Form. & Loc. Cenomanian: Cambridge.

P. 7238. The type specimen, described and figured *loc. cit.*; Cambridge Greensand, Cambridge. The dentition measures 0·02 in maximum width and 0·04 in length. *Jesson Coll.*

The following form of vomer may belong either to *Athrodon* or to *Mesodon*:—

P. 7186. Imperfect vomerine dentition, shown of the natural size in Pl. XVII. fig. 2; Portland Stone, near Weymouth. The teeth are widely spaced on a transversely-convex surface, and arranged in seven series. All are smooth, but much worn; and even the principal median teeth are scarcely broader than long. *Purchased*, 1894.

P. 3750. Left lateral teeth of a similar vomer; Portland Stone, near Weymouth. *Enniskillen Coll.*

The following species have also been founded on detached splenial bones, of which there are no examples in the Collection:—

Athrodon boloniensis, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 531, pl. xix. fig. 6.—Lower Kimmeridgian; Brecque-recque, Boulogne. [School of Mines, Paris.]

Athrodon profusidens, A. S. Woodward, Geol. Mag. [3] vol. x. (1893), p. 435. *Pycnodus profusidens*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 609, pl. xi. figs. 3–6. *Mesodon profusidens*, A. Gaudry, Enchaîn. Monde Anim., Foss. Second. (1890), p. 164, fig. 262.—Neocomian; Wassy, Haute Marne.

Athrodon tenuis, A. S. Woodward, *loc. cit.* (1893), p. 435, pl. xvi. fig. 2.—Lower Senonian; Lonzée, near Gembloux, Belgium. [Brussels Royal Museum of Natural History.]

Athrodon wittei, H. E. Sauvage, *loc. cit.* (1880), p. 531. *Mesodon wittei*, K. Fricke, Palæontogr. vol. xxii. (1875), p. 364, pl. xix. fig. 15.—Lower Kimmeridgian; Hanover.

An imperfect vomerine dentition from the Cambridge Greensand, in the Woodwardian Museum, Cambridge, is also not improbably referable to *Athrodon* (A. S. Woodward, *loc. cit.* 1893, p. 435, pl. xvi. fig. 4).

Genus **MESTURUS,** Wagner.

[Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1862, p. 338.]

Trunk discoidal, abruptly produced into a small and short caudal pedicle. Head and opercular bones externally ornamented with granulations; teeth with a crimped and usually indented coronal apex; vomerine teeth arranged in three principal series, with a varying number of irregular, small, intercalated series; splenial dentition comprising one principal series of teeth, with about two inner and several outer irregular series of smaller teeth. Fin-rays robust, closely articulated, and much divided distally. Pelvic fins present; dorsal and anal fins deep throughout their extent, not specially elevated in front, and the former occupying about the hinder half of the back; caudal fin fan-shaped, having a sinuously convex hinder margin, and nearly surrounding the short caudal pedicle. Scales robust and covering the whole of the trunk; their upper and lower margins united by interlocking digitations, and their external surface tuberculated.

Mesturus verrucosus, Wagner.

[Plate XV.]

1862. *Mesturus verrucosus,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 338, pl. iii. fig. 1.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·5. Maximum depth of trunk considerably exceeding its length from the scapular arch to the base of the caudal pedicle, and head with opercular apparatus occupying nearly one-third of the total length of the fish (including caudal fin). [Dentition unsatisfactorily known, but] the teeth of the outermost series on the splenial little inferior in size to those of the principal series. Dorsal fin with 32 rays, arising at the middle of the back behind its highest point; [anal fin incompletely known]. Tubercular ornamentation of the scales fine and closely arranged compared with that of the head-bones, except in the anterior half of the lateral line, where the tubercles form a series of irregular excrescences. All the principal scales exhibiting fine structural lines radiating backwards from a point on their anterior margin, beneath the tubercular ornamentation. The vertical series of scales irregularly bifurcating towards the whole of the dorsal margin and towards the caudal half of the ventral margin.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

1949. M.V. P. de Saint-Seine N. Archiv. Mus. N. H. Lyon
2 106 ff. 38, 39, pl. vii.

49147. Plaster cast of type specimen; Eichstädt. *Purchased*, 1878.

37023. A fine specimen, in counterpart, with crushed head and wanting part of the ventral margin; Solenhofen. The best side of the fossil is shown of one-half the natural size in Pl. XV. fig. 1, with some parts restored from the opposite side. The bones of the cranial roof are shown to be especially thick and marked with a relatively coarse tubercular ornament. The facial bones are remarkably delicate and finely tuberculated, exhibited as very irregular large tesseræ below the orbit, and represented by the remains of one long narrow plate (*x*) above the upper jaw. The sclerotic of the eye is ossified (*scl.*). The margin of the vomer (*vo.*) is exposed in the upper, and that of the splenial (*spl.*) in the lower jaw, both of these bearing stout teeth on moderately elongated pedicles; and the external face of the mandible is completed by the tuberculated dentary (*d.*) and angular (*ag.*) plates. The postero-superior portion of the mandible, however, is obscured by the thin facial bones. Still further below the skull are two elements which seem to be identifiable as ceratohyal (*ch.*) and hypohyal (*hy.*); both very small, and the former remarkably deepened behind. Among the remains of branchial and branchiostegal apparatus, the calcified gill-filaments (fig. 1 *a*) are especially conspicuous, each exhibiting a widely spaced series of very fine denticles on its upper margin. Fragments of the operculum (*op.*) indicate that this plate was as coarsely tuberculated as the cranial roof; so also, in part at least, was the preoperculum (*p.op.*), which is displayed almost entirely from its inner aspect, and seems to be bounded below in the counterpart of this fossil by one or perhaps two branchiostegal rays. Below the opercular apparatus are observed very small, tuberculated, imbricating scales, which are more or less lozenge-shaped and broader than deep, and extend as a covering between the rami of the mandible. The neural spines (*n.*) of the vertebral axis are exhibited enveloped in the squamation, those in the abdominal region thickened and extending almost or quite to the dorsal ridge. As shown by impressions in the counterpart, they are about 30 in number to the base of the caudal pedicle. Immediately behind the opercular apparatus are remains of the clavicle, ornamented with large tubercles on its lower expansion (*cl.*);

and in the short lobe at the base of the pectoral fin there are portions of the long, hour-glass-shaped supporting cartilages (*p.b.*), which were probably not less than nine in number. Thirty-five rays can be distinctly observed in the pectoral fin on the counterpart, and there may have been a few more; about five of the foremost rays gradually increase in length and seem to have been undivided, while the remainder are divided and sparsely articulated distally. The region which would support the pelvic fins is broken away, and the anterior portion of the anal fin is similarly destroyed. The dorsal and caudal fins, however, are very satisfactorily preserved. The dorsal is borne on 31 or 32 supports, and seems to be slightly the deepest at its middle; there are two short and stout basal rays (or a ridge-scale and a ray) in front, undivided, and the second somewhat longer than the first; then three gradually lengthening rays succeed, each articulated but not branching; and the remainder of the fin consists of 28 well-spaced rays, each very stout, closely articulated, widened, and dichotomously branching from a point quite close to its base. The anal fin-rays are similar, as also are those forming the middle part of the tail. The caudal fin is fan-shaped, surrounding the hinder half of the pedicle, and having a sinuously convex posterior border. Its marginal rays above and below are simple, and gradually increase in length, while the fifth or sixth is the first exhibiting articulations. All the principal characters of the squamation are displayed, and the scales of the whole of the flank are shown to be united above and below by the characteristic jagged suture (fig. 1 *b*). The fine lines radiating beneath the tubercular ornament from a point on the anterior margin of many scales are apparently a structural feature; the radiation being exhibited also to some extent on the inner face of some scales exposed near the ventral border. The vertical flank-series become irregular as they approach the dorsal margin throughout the trunk, and towards the ventral margin in the caudal region. Intercalary vertical series (*ic.*) of variable length are thrust between them. At the base of the dorsal and anal fins they are subdivided into very small, irregularly lozenge-shaped scales; and the arrangement of the small scales on the caudal lobe is also not very regular. A few narrow scales, likewise not con-

Mesturus leedsi A.S. Woodward, 1898, Vertebrate Palaeontology, p. 102-4, fig. 73.
Mesturus leedsi A.S. Woodward, 1896, (Type) Ann. Mag. Nat. Hist. [6] Vol. XVII p. 2. pls. 1, 3. fig.

Polypsephis Hay 1899, Amer. Naturalist 33, p. 788.
Pycnomicrodon ? (P. leeanus W.S. Adkins, Bull. Univ. Texas 2313 (1923) p. 201.) see p. 232.
Syn. Proscinetes, J. Gistel, Naturgesch. Thierreichs, 1848, p. X [Name only, M. preoccupied.]
Cirinodon, G. Steinmann, Pal. Zeitschr. vol. ix (1927) p. 50 [Pars. for M. sawanausi + itiori]
Microdorhynchus, G. Steinmann (ibid.) p. 67, [Pars, for M. wagneri + bernardi].

formable with the vertical flank-series, are observed at the base of the lobe of the pectoral fin; while those of the gular and branchiostegal region have already been noticed. *Häberlein Coll.*

Mesturus leedsi, sp. nov.

Type. Imperfect head and trunk; collection of Alfred N. Leeds, Esq., Eyebury.

A larger species than *M. verrucosus*, with more coarsely and sparsely tuberculated scales, which do not exhibit any radiating lines. No enlarged tubercles on the course of the lateral line. Premaxilla with three, dentary with four prehensile teeth. Vomerine and splenial teeth smooth, exhibiting a shallow apical indentation with a crimped margin, very rarely also with a slight median tubercle; shape of indentation varying with that of the tooth, and the hinder portion of its crimped border not infrequently wanting. Oral surface of vomer flat, with outer lateral teeth not much inferior in size to those of the median series; inner lateral teeth less than half as large as these, very irregular and much supplemented behind. Splenial dentition comprising one principal longitudinal series of teeth, all oval and about as large as the median vomerine teeth, but with long axis oblique; outermost series regular and similar, but rather smaller; one regular row of round teeth about half as large, and an innermost irregular row of still smaller teeth, within the principal series; two similar rows of small teeth also interposed between the latter and the outermost series, but these again irregularly supplemented in the hinder two-thirds of the bone.

Form. & Loc. Oxfordian: Huntingdonshire.

P. 6834. Associated series of bones isolated from matrix; Oxford Clay, near Peterborough. In the nomenclature here adopted the series comprises the parasphenoid, basisphenoid, right postfrontal, right and left squamosal, portion of right frontal, right and left operculum, and other fragments. *Leeds Coll.*

? Pycnomicrodon May 1916 ann. Revue. Bull. 71, p. 6.

Genus **MICRODON,** Agassiz[1].

[Poiss. Foss. vol. ii. pt. i. 1833, p. 16, pt. ii. 1844, p. 204.]

Trunk deeply fusiform, often almost discoidal, with a slender abbreviated caudal pedicle. Head and opercular bones ornamented

[1] This name having gained universal acceptance, we adopt it, notwithstanding its preoccupation among Diptera by *Microdon*, Meigen, 1803.

with reticulating rugæ and pittings; teeth smooth, sometimes feebly indented in the lateral series; vomerine teeth in five longitudinal series, the inner lateral pairs regularly alternating with the widely spaced median teeth; splenial teeth in four series, the innermost being relatively small, and the second the largest or principal series. Neural and hæmal arches of axial skeleton of trunk not expanding sufficiently to encircle the notochord. Fin-rays robust, closely articulated, and much divided distally. Pelvic fins present; dorsal and anal fins very high and acuminate in front, rapidly becoming low and fringe-like behind, the former occupying at least the hinder half of the back and the latter somewhat shorter, arising more posteriorly; caudal fin forked. Scales ornamented with reticulating rugæ or pittings, and covering only the anterior half of the trunk in advance of the median fins, though sometimes partly extended over the middle of the flank of the caudal region.

Microdon elegans, Agassiz.

1833–44. *Microdon elegans*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 16, pt. ii. p. 205, pl. lxix. *b*.

(?) 1839. *Gyrodus laticauda*, G. von Münster, Neues Jahrb. p. 679.

1843. *Microdon notabilis*, G. von Münster, Beitr. Petrefakt. pt. vi. p. 55, pl. ii. fig. 2. [Mandibular dentition; Palæontological Museum, Munich.]

1851. *Pycnodus elegans*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. pp. 33, 36.

1851. *Pycnodus notabilis*, A. Wagner, *ibid.* vol. vi. pp. 37, 57, pl. iii. fig. 3.

1862. *Microdon elegans*, A. Wagner, *ibid.* vol. ix. p. 343.

(?) 1862. *Microdon nanus*, A. Wagner, *ibid.* vol. ix. p. 344. [Immature fish; Palæontological Museum, Munich.]

1887. *Microdon elegans*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 246, fig. 259.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·3. Maximum depth of trunk equalling about four-fifths of the length of the head and trunk without caudal fin; head with opercular apparatus occupying slightly more than one-quarter of the total length of the fish. Splenial teeth closely arranged; those of the principal series somewhat broader than long and truncated at each end; innermost teeth and those of the inner flanking series about equal in size, very small and sometimes longer than broad; outermost teeth irregularly quadrate, longer than broad, about half as large as the principal

1912. Micrvdon notabilis, E. Stromer v. Reichenbach, Lehrb. d. Paläozool. pt. ii. p. 32, fig. 43. [Type mandible]

1949. M. elegans, P. de la Sauv. Secna N. Arch. Mus. N.H. Lyon 2 p. 122 ff. 48-49 pl. xi fig. B.

1918. *Microdon radiatus*, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 59, pl. xiv. pl. xv. figs. 1–5; text-fig. 23.

Restoration by A. S. W. 1918, p. 60, text-fig. 23.

19013. Caudal fin des.? & fig.? A. S. W. *loc. cit.* 1918, p. 63, pl. xv. fig. 2.

teeth. Vertebral axis at origin of dorsal fin midway between the dorsal and ventral borders of the fish. Dorsal fin with more than 50 rays, occupying considerably more than half of the back, much more elevated than the anal fin, which has 45 rays, and the length of which equals about three-quarters that of the dorsal. Ridge-scales coarsely serrated; flank-scales delicate, marked with feeble rugæ, which are mostly transverse.

A small fish in the Palæontological Museum, Munich, not improbably young of this species, is named *Microdon nanus*, A. Wagner, *loc. cit.* vol. ix. (1862) p. 344.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37369. Plaster cast of type specimen; Kelheim. *Purchased*, 1863.

P. 1626, P. 3764. Fine large specimen partly in counterpart, showing remains of the pelvic fins; Solenhofen.
Egerton and Enniskillen Colls.

P. 1631. Caudal region, with nearly complete caudal fin; Kelheim.
Egerton Coll.

P. 3765. Imperfect caudal fin; Kelheim. *Enniskillen Coll.*

Microdon radiatus, Agassiz.

1839–44. *Microdon radiatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 208, pl. lxix. *c.* figs. 1, 2.
1840. *Microdon radiatus*, R. Owen, Odontography, p. 73, pl. xliii. fig. 1.

Type. Imperfect fishes.

A much smaller species than the type, nearly similar in general form and proportions, but with relatively deeper abdominal region. Principal series of splenial teeth wider than the two outer series, of which the outermost is considerably the largest. Ridge-scales with three or four coarse serrations, of which the hindermost is a large denticle; flank-scales robust, marked with prominent rugæ which are mostly transverse and radiating.

The laminar expansions on the neural and hæmal arches are well shown in several specimens recorded below, proving that their absence in the original fossils examined by Agassiz was accidental. The neural spines are remarkably robust in the abdominal region.

Form. & Loc. Purbeckian: Dorsetshire.

All the following specimens were obtained from the neighbourhood of Swanage:—

19013. Fish 0·105 in length, wanting the pelvic fins and the greater part of the dorsal and anal fins. *Purchased*, 1844.

28443. Two more imperfect specimens, somewhat larger. One displays the posterior process of the parietal, arising beneath the outer layer of this bone. *Cunnington Coll.*

44844. Fish 0·13 in length, wanting most of the fins but displaying part of the ornamented squamation. In this, as in the other specimens, the scales seem to have been much more robust in the ventral than in the dorsal region.
Presented by Benjamin Bright, Esq., 1873.

46333. Well-preserved trunk and cranium of a slightly larger fish, with portions of the pelvic and median fins.
Cunnington Coll.

P. 1627. Four specimens in various states of preservation, two displaying the splenial dentition, and one the hyo-mandibular bone. *Egerton Coll.*

P. 5592. Remains of head and trunk, displaying scales and splenial dentition. *Harford Coll.*

22403. Remains of small head and trunk, displaying the ridge-scales. *Purchased*, 1848.

P. 7455. Cranium in side view. *History unknown.*

33481. Right splenial dentition. *Purchased*, 1858.

The following specimens of vomerine dentition from Swanage may pertain to *Microdon radiatus*, but they are relatively large. They differ from the corresponding dentition of *M. pagoda* only in the relatively smaller size of the outer paired teeth:—

21974. Vomerine dentition preserved for a length of 0·019.
Purchased, 1848.

P. 6820. A somewhat larger specimen. *Purchased*, 1892.

Microdon bernardi (Thiollière).

1854. *Pycnodus bernardi*, V. Thiollière, Poiss. Foss. Bugey, pt. i. p. 17, with plate.
1856. *Microdon bernardi*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 201.
1860. *Microdon bernardi*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 396.

Type. Nearly complete fish; Lyons Museum.

A species as large as the type species. Maximum depth of trunk equalling about two-thirds of the length of the head and trunk

8443. Ceratohyal & epihyal des? & fig? A.S.W. loc. cit. 1918, p. 62, pl. xiv. fig. 9.

8444. Flank-scales des? & fig? A.S.W. loc. cit. 1918, p. 64, pl. xv. fig. 4. Maxilla noticed, p. 61. Clavicle noticed, p. 63.

6333. Des? & fig? A.S.W. loc. cit. 1918, p. 59, pl. xiv. fig. 2. Flank-scales enlarged, p. 64, pl. xv. fig. 3.
P. 1627a. Left parietal and right splenial des? & fig? A.S.W. loc. cit. 1918, pp. 60, 62, pl. xiv. figs. 4, 8.
P. 1627b. Hyomandibular, &c., des? & fig? loc. cit. p. 61, pl. xiv. fig. 10.
2. 5592. Splenials des? & fig? loc. cit. p. 62, pl. xiv. fig. 7.

P. 7455. Des? & fig? loc. cit. 1918, p. 59, pl. xv. fig. 1.

914. Microdon bernardi, C.R. Eastman, Mem. Carnegie Mus. vol. vi. p. 367, pl. 7ii.
(see p. 221)
649. M.L. P. de Saint-Seine, N. Cerebrin. Mem. H.N. Lyon 2 p. 111, H. 41-43 pls. ix, x.

1914. Microdon wagneri, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 368, pl 7iii.

1949. Gyrodus wagneri P. de Saint-Seine N. Arch. Mus. N. H. Lyon 2 p 127 fig. 54, 55, pl. xiii f. B, xiv f. B.

without caudal fin; rostrum prominent, and head with opercular apparatus occupying somewhat less than one-quarter of the total length of the fish. Vertebral axis at origin of dorsal fin midway between the dorsal and ventral borders of the fish. Principal series of mandibular teeth much wider than the two outer series, of which the innermost is insignificant. Dorsal fin occupying considerably more than half of the back, much more elevated than the anal fin, which is also shorter. Ridge-scales delicate on the back, robust but feebly serrated on the ventral border; flank-scales ornamented with delicate radiating rugæ.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France, and (?) Bavaria.

P. 1635. A typical specimen in counterpart, much disturbed; Cirin, Ain. *Egerton Coll.*

P. 4693. Imperfect trunk; Cirin. *Purchased*, 1884.

49132. Plaster cast of a small fish, probably of this species; Kelheim, Bavaria. *Purchased*, 1878.

Gyrodus

Microdon wagneri (Thiollière).

1854. *Pycnodus wagneri*, V. Thiollière, Poiss. Foss. Bugey, pt. i. p. 23, with figure.

1856. *Microdon wagneri*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 201.

1860. *Microdon wagneri*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 396.

Type. Nearly complete fish; Lyons Museum.

A species resembling the type in size, general form, and proportions, and apparently only differing in the extension of the squamation over the middle of the flank of the anterior half of the caudal region.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 1636. A fine specimen 0·25 in length preserved in impression and wanting the rostral portion of the skull; Cirin. The ribs of the scales originally on the flanks of the caudal region are indicated; and the form of the hinder part of the trunk suggests that the figured type specimen has been somewhat distorted by crushing in that region.

Egerton Coll.

P. 4694. Imperfect fish, displaying the expansion at the inferior end of the problematical bone (? ridge scute) at the hinder extremity of the body-cavity ; Cirin. *Purchased*, 1884.

Microdon egertoni (Thiollière).

1854. *Pycnodus egertoni*, V. Thiollière, Poiss. Foss. Bugey, pt. i. p. 24, with figure.
1856. *Microdon egertoni*, J. J. Heckel, Denkschr. k. Akad. Wiss. math.-naturw. Cl. vol. xi. p. 201.
1860. *Microdon egertoni*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. vol. l. p. 396.

Type. Nearly complete fish ; Lyons Museum.

A small form of *Microdon*, not yet satisfactorily distinguished from the type species. It is stated to differ in not exhibiting an angulation of the frontal profile and in having fewer vertebræ ; but the first character may be due to imperfect preservation, and the second is difficult to observe with certainty.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone) : Ain, France.

P. 1637. Imperfect, crushed specimen 0·13 in length, shown for the most part in impression ; Cirin. *Egerton Coll.*

P. 4695. Slightly larger specimen displaying the pelvic and median fins, but wanting the greater part of the head ; Cirin. *Purchased*, 1884.

Microdon sauvanausi (Thiollière).

1850. *Pycnodus sauvanausi*, V. Thiollière, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 131.
1854. *Pycnodus sauvanausii*, V. Thiollière, Poiss. Foss. Bugey, pt. i. p. 15, with plate.
1856. *Microdon sauvanausii*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 201.

Type. Nearly complete fish ; Lyons Museum.

A large species attaining a length of about 0·6. Maximum depth of trunk apparently equalling about half of the length of the head and trunk without caudal fin ; head with opercular apparatus occupying somewhat more than one-quarter of the total length of the fish. Each premaxilla with two chisel-shaped teeth ; [other teeth imperfectly known]. Scales apparently confined to the most anterior part of the trunk.

A fish from Cirin described as intermediate between this and the

1949. M. E. P. de Saint-Simon, N. Arch. Mus. H.N. Lyon 2me. publ. 17. 44 pl. 3 bis f. D.

1914. Microdon egertoni, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 369, pl. 71 v. fig. 1.

1951. M. cf. egertoni L.F. Conrad. Not. Com. Inst. geol. Espagne 23 p. 10, pl. ii f. 2. U. Lut. Spain

Microdon aff. egertoni, H. E. Sauvage, Mem. R. Acad. Ciencias Barcelona [3] vol. iv. no. 35 (1903), p. 10. pl. iv. fig. 4. = F. Braila, 1933, p. 9, pl. i. f.

1914. Microdon sauvanausi, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 369, pl. 71 v. fig. 2.

1949. M. S. P. de Saint-Simon, N. Archiv. Mus. N.H. Lyon 2 p. 120 fig. 47 pl. xii f. A.

1914. Micrurodus itieiri, C. R. Eastman, Mem. Carnegie Mus.
vol. vi. p. 371, text-fig. 2 [splenial].

1930. Pycnodus itieri, S. Thomas et°, fig. 46
(Atnecaris gluckh).

1949. M. i. P. de Saint-Seine, N. Archiv. Mus. N.H. Lyon
2 p. 118, Hfs 45, 46 pl. xi f. A.

following species is named *Microdon intermedius*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. (1860), p. 398.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Cirin, Ain, France.

Not represented in the Collection.

Microdon itieri (Thiollière).

1850. *Pycnodus itieri*, V. Thiollière, Ann. Soc. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 132.

1854. *Pycnodus itieri*, V. Thiollière, Poiss. Foss. Bugey, pt. i. p. 22, with plate and woodcut of dentition.

1856. *Microdon itieri*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 201.

1860. *Microdon itieri*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 396.

Type. Nearly complete fish; Lyons Museum.

A moderately elongated species attaining a length of about 0·5. Maximum depth of trunk contained three times in the length of the head and trunk without caudal fin; head with opercular apparatus occupying only about one-fifth of the total length of the fish. Vomerine teeth closely arranged; those of the median series much broader than long; those of the inner paired series elongated and their axis oblique, each pair alternating with the median teeth but scarcely pressed between these; outer teeth irregularly quadrate, about as broad as long, and very closely arranged. Splenial teeth (according to Thiollière's diagram) much spaced; those of the principal series two or three times as broad as long, rounded at each end; those of the innermost series minute, and those of the two flanking series somewhat broader than long, the outer twice as large as those of the inner flanking row. Dorsal fin occupying about half of the back, and anal fin more than two-thirds as much extended as this. Scales apparently confined to the most anterior portion of the trunk.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Cirin, Ain, France.

Not represented in the Collection.

Microdon hugii (Agassiz).

[Plate XVII. fig. 3.]

1833-44. *Pycnodus hugii*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17, pt. ii. p. 195, pl. lxxii. *a*. figs. 49–54.

1846. *Pycnodus bucklandi*, G. von Münster (*errore*), Beitr. Petrefakt. pt. vii. p. 40, pl. iii. figs. 5 *a*, *b*.

1846. *Pycnodus preussi*, G. von Münster, *ibid.* p. 45, pl. ii. fig. 25. [Splenial; Palæontological Museum, Munich.]

1852. *Pycnodus hugii*, F. A. Quenstedt, Handb. Petrefakt. p. 213, pl. xvi. fig. 10.
1856. *Microdon hugii*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 201.
(?) 1858. *Pyknodus hugii*, F. A. Quenstedt, Der Jura, p. 781, pl. xcvi. figs. 30, 31.
1860. *Pycnodus hugii*, F. J. Pictet, Rept. & Poiss. Foss. Jura Neuchâtelois, p. 56, pl. xiii. figs. 4–8, pl. xix. fig. 2.
(?) 1860. *Pycnodus notabilis*, F. J. Pictet (? *errore*), *ibid.* p. 58, pl. xiv. fig. 1.
1864. *Pycnodus irregularis*, H. Credner (*errore*), Zeitschr. deutsch. geol. Ges. vol. xvi. p. 244, pl. xi. fig. 5.
1875. *Microdon hugii*, K. Fricke, Palæontogr. vol. xxii. p. 371, pl. xx. figs. 10–16.
1880. *Microdon hugii*, C. Struckmann, Wealdenbild. Hannover, p. 90, pl. iii. fig. 8.

Type. Portions of mandibular dentition; Soleure Museum.

A large species, known only by the dentition. Vomerine dentition [according to Fricke] very narrow, and the teeth of the median and inner paired series widely spaced; median teeth of irregularly rounded form, scarcely broader than long; those of the inner paired series irregularly triangular or quadrangular, antero-posteriorly elongated; those of the outer paired series narrowest and much elongated antero-posteriorly. Splenial teeth closely arranged; those of the principal series about twice as broad as long and more or less truncated at their outer end; those of the innermost series and of the inner flanking series relatively small and about equal in size; those of the outermost series larger than the latter, though less than half as large as the principal teeth, slightly elongated transversely and truncated at the inner end.

The largest known splenial dentition measures about 0·05 in length, and the irregular subdivision of some of the teeth is frequently observed.

Form. & Loc. Corallian and Kimmeridgian: Hanover, Würtemberg, an Switzerland. Portlandian: Hanover; (?) also S. England. Purbeckian: Hanover. V. Mala. Purbeck.

P. 1654 a, b. Left splenial dentition, somewhat broken, and another abnormal fragmentary specimen; Kimmeridgian, Soleure, Switzerland. *Egerton Coll.*

P. 7443. Left splenial; Kimmeridgian, Sohlewerke, Hanover. *Purchased*, 1895.

P. 2297. Imperfect small left splenial dentition; Portlandian, Hanover. *Presented by Mrs. Burton*, 1882.

1898. M. l. W. Lawrence, Ver. Fos. Portugal. 15 pl. 1. f. 6

1903. Microdon hugii, L. Coulon, Bull. Soc. Étude Sci. Nat. Elbeuf, 24th. year 1902, p. 147, fig. 10.

1911. Microdon hugii, F. Priem, Ann. Paléont. vol. vi. p. 10, pl. iii. figs. 1-8. [U. Sequanian, Tonnerre, Yonne.]

1911. Microdon hugii, F. Priem, var. jullieni, Ann. Paléont. vol. vi. p. 12, pl. iii. figs. 9, 10. [Ibid.]

1912. Microdon hugii, F. Priem, Bull. Soc. Géol. France [4] vol. xii. p. 254, pl. viii. fig. 6. [U. Jurassic; Drôme.]

1916. Microdon hugii, F. Priem, Bull. Soc. Géol. France [4] vol. xvi. p. 292, pl. viii. figs. 4, 5. [Barremian; Orgon.]

1946. M. l. L. Hennig p. 43 f. 7.

P. 1650, P. 3748. Right and left splenial dentition, of small size; Corallian, Lindnerberg, Hanover.

Egerton and Enniskillen Colls.

30871. Left splenial dentition, probably of this species, shown of the natural size in Pl. XVII. fig. 3; Portland Stone, Weymouth. *Purchased*, 1856.

Microdon minutus (Münster).

1846. *Pycnodus minutus*, G. von Münster, Beitr. Petrefakt. pt. vii. p. 41, pl. iii. fig. 7.

1875. *Microdon minutus*, K. Fricke, Palæontogr. vol. xxii. p. 369, pl. xx. figs. 5–9.

Type. Fragment of mandibular dentition; Palæontological Museum, Munich.

A species of moderate size, known only by the dentition. On the vomer [according to Fricke] the teeth of the principal series much transversely elongated, comparatively closely arranged; those of the inner paired series minute or aborted; those of the outer paired series small and irregularly rounded. Splenial teeth closely arranged; those of the principal series at least twice as broad as long; those of the innermost series round and minute; those of the inner flanking series much transversely elongated, relatively large, and those of the outer flanking series smaller, either round or slightly elongated transversely.

Form. & Loc. Kimmeridgian: Hanover; Switzerland.

P. 3747. Left splenial dentition; Lindnerberg, Hanover.

Enniskillen Coll.

P. 3746 a. Portion of larger right splenial dentition; Soleure, Switzerland. *Enniskillen Coll.*

Microdon quincuncialis (Blake).

1875. *Pycnodus quincuncialis*, J. F. Blake, Quart. Journ. Geol. Soc. vol. xxxi. p. 223.

1880. *Pycnodus quincuncialis*, R. Damon, Geol. Weymouth, ed. 2, Suppl. pl. xi. fig. 10.

1890. *Microdon quincuncialis*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 122.

Type. Vomerine dentition; British Museum.

A species of large size. Inner vomerine teeth sparsely arranged, those of the principal series not much broader than long, and the paired teeth very irregular in size and form, with few supplementary

minute teeth; teeth of the outer paired series closely arranged, longer than broad, and truncated externally.

Form. & Loc. Kimmeridgian: Dorsetshire.

P. 6170. Type specimen; Lower Kimmeridge Clay, Weymouth.
Damon Coll.

P. 6749. Imperfect right splenial dentition probably of this species, though possibly an abnormal example of *Gyrodus coccoderma*, exhibiting the principal teeth of a very irregular form, scarcely broader than long, and the inner flanking series slightly larger than the outer series; Weymouth.
Purchased, 1892.

47965. Larger imperfect specimen of the same form of splenial dentition; Coral Rag, Wheatley.
Presented by the Hon. Robert Marsham, 1877.

Microdon pagoda (Blake).

1880. *Pycnodus pagoda*, J. F. Blake, Quart. Journ. Geol. Soc. vol. xxxvi. p. 228, pl. x. fig. 10.
1889. *Microdon pagoda*, A. S. Woodward, Geol. Mag. [3] vol. vi. p. 454.

Type. Vomerine dentition; British Museum.

A species of small or moderate size, known only by the vomerine dentition, which is somewhat arched from side to side. Teeth of the median or principal series at least twice as broad as long; those of the inner pair about half as large as the latter, with tendency to oblique elongation; those of the outer paired series much smaller, irregular in shape and size, and not much truncated externally.

Form. & Loc. Portlandian: Dorsetshire.

40640 a. Vomerine dentition; Portland Stone, near Weymouth.
Purchased, 1867.

P. 4678. Smaller specimen; Ridgway Quarry, near Weymouth.
Presented by C. Westendarp, Esq., 1884.

P. 7187. Another small vomer; near Weymouth. *Purchased*, 1894.

Microdon biserialis, A. S. Woodward.

1844. *Pycnodus biserialis*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 199 (name only).
1890. *Mesodon biserialis*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 300, pl. iii. fig. 28.

Type. Left splenial dentition British Museum.

P. 10565. Vomer, the type specimen; Elsmag.
Purch? J. Badcock, 1907.

In. coralli, F. Riem, Ann Paléont. vol. vi (1911), p. 12.

A species of small or moderate size, known only by the splenial dentition. Teeth closely arranged; those of the innermost series minute and round; those of the principal series about twice as broad as long; teeth of the inner flanking series broader than long and larger than those of the outermost row, which are rounded.

Form. & Loc. Bathonian: Oxfordshire.

P. 523. Type specimen; Stonesfield Slate, Stonesfield. *Egerton Coll.*

Microdon (?) **discoides** (A. S. Woodward).

1844. *Pycnodus discoides*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 199 (name only).

1890. *Mesodon discoides*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 300, pl. iii. fig. 32.

Type. Imperfect vomer; British Museum.

A species doubtfully ascribed to *Microdon*, known only by the unique vomer recorded below. Vomerine teeth round and well spaced; those of the median series not much exceeding the outer lateral teeth in size; inner paired teeth only about half as large as the others.

Form. & Loc. Bathonian: Oxfordshire.

P. 524. Type specimen, described and figured *loc. cit.* 1890; Great Oolite, Little Gibraltar, near Oxford. *Egerton Coll.*

The following specimens of *Mesodon* are not specifically determined:—

P. 7444. Vomer; Kimmeridgian, Langenberg, Hanover. *Purchased*, 1895.

P. 3756. Vomer resembling *Microdon* in its anterior half, but the inner lateral teeth not interposed between the median teeth in its hinder half; Purbeckian, Swanage. *Enniskillen Coll.*

The following species of *Microdon* have also been founded upon portions of dentition, but there are no examples in the Collection:—

Microdon coralli: *Pycnodus coralli*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 32, pl. ii. fig. 2.—Upper Corallian; Tonnerre, Yonne, France. [Right splenial; Cotteau Collection.]

Microdon distantidens: *Pycnodus distantidens*, F. J. Pictet, Rept. et Poiss. Foss. Jura Neuchâtelois (1860), p. 67, pl. xv.

fig. 6. — Kimmeridgian ; Chaux-du-Milieu, Neuchâtel. [Portion of vomer ; Neuchâtel Museum.]

Microdon formosus, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. (1856), p. 201. *Pycnodus formosus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. (1851), p. 40, pl. iii. fig. 4.—Lower Kimmeridgian (Diceras-kalk) ; Oberau, near Kelheim, Bavaria. [Portion of right splenial ; Palæontological Museum, Munich.]

Microdon irregularis : *Pyknodus irregularis*, F. A. Quenstedt, Der Jura (1858), p. 781, pl. xcvi. fig. 32 [1].—Upper Corallian ; Schnaitheim, Würtemberg. [Portion of vomer ; Tübingen University Museum.]

Microdon (?) *minor* ; *Pycnodus minor*, F. A. Roemer, Verstein. Norddeutsch. Oolithengeb., Nachtr. (1839), p. 54. — Portlandian ; Galgenberg, near Hildesheim, Hanover. [Splenial.]

Microdon vicinus : *Pycnodus vicinus*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. xi. (1883), p. 20, pl. i. figs. 8, 9.—Portlandian ; Ville-sur-Saulx, Meuse. [Splenial.]

An undefined species of *Microdon* is also indicated by imperfect jaws from the Lower Kimmeridgian of Orbagnoux, Ain, France (*Pycnodus* sp., H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. 1893, p. 443, pl. ix. fig. 2).

The genus has been erroneously recorded from the Cretaceous. The so-called *Microdon nuchalis* (F. Dixon, Geol. Sussex, 1850, p. 369, pl. xxxii. fig. 7) is founded upon an imperfect example of a teleostean fish from the Chalk of Sussex, now in the British Museum (*Platax* ? *nuchalis*, A. S. Woodward, Ann. Mag. Nat. Hist. [5] vol. xx. 1887, p. 342). *Microdon occipitalis* (F. Dixon, *op. cit.* p. 369, pl. xxxii*. fig. 2) is a name given to a generically indeterminable fragment of a Pycnodont from the Chalk of Lewes, in the Brighton Museum.

Microdon ? *pulchellus* (J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. 1887, p. 501, pl. xxiv. fig. 3), from the Upper Cretaceous of Sahel Alma, Mt. Lebanon, is a teleostean fish. The type specimen is now in the Edinburgh Museum.

An indeterminable fossil from the Cretaceous of Pietraroja, Naples, is named *Microdon simplex*, O. G. Costa, Atti Accad. Pontan. vol. viii. (1864), p. 112, pl. ix. fig. 7. Hist. foss. Ital. (1856) p. 23, pl. ii. f. 7

[1] An Eocene fossil from Bavaria, certainly not of this species is recorded under the same name by K. Schafhäutl, Süd-Bayerns Leth. Geogn. (1863), p. 246 pl. lxv. *c*. fig. 16.

M. distomidens, P. de Saint-Seine 1949, N. Arch. Mus. N.H. Lyon 2 p. 123 Hf. 50 pl. xi f. c.

Microdon Theilleri s.n. P. de Saint-Seine 1949, N. Arch. Mus. N.H. Lyon 2 p. 123, Hf. 51 pl. xii f. B, C. Foss: Mus. N.H. Lyon; Kimm. Cerin.

Microdon texanus, J. W. Gidley, Proc. U.S. Nat. Mus. vol. 46 (1913), p. 445, figs. 1, 2. — L. Cretaceous; Hamilton County, Texas. [Vomer; U.S. Nat. Mus.] ~~separamicrodon~~ Pycnomicrodon (g.n.) O.P. Hay 1916, Univ. Texas Bull VI. p. 6.

Pycnomicrodon (g.n. von Hay) kansasensis s.n. Cl. W. Hibbard in Graffham 1941 Univ. Kansas Sci. Bull. 27 p. 71 1 Hf. 1 pl. U. Cret. Kansas: Shumard Kansas Univ. Micropycnodon nom. nov.: kansasensis. Hibbard & Graffham 1945. Tr. Kansas Acad. Sci. 47 p. 404. M. K. Brandle & Hibbard 1946. Un. Kansas Sci. Bull. 31 p. 166. 2 Hf. pls. vii - ix.

Mecistocephalus T. Orvis 1951 Arkiv Zool. (2) 2 17 7a.

1953. G. of. m. H. Dunkle & M. Maldonado-Koerdell, Contrib. Acad. Sci. 43 10 p. 3 fig. 1. Kinsmen, Mexico.

1914. Gyrodus macrophthalmus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 410, pl. lxix. fig. 1.

1923. Gyr. macroph. cubensis, W. K. Gregory, Bull. Amer. Mus. N.H. vol. xlviii. p. 224, figs. 1, 2. [Dentition; Cuba.]

Genus **GYRODUS,** Agassiz.

[Poiss. Foss. vol. ii. pt. i. 1833, p. 16, and pt. ii. 1844, p. 223.]

Syn. *Stromateus,* H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. 1818, p. 333.

Trunk deeply fusiform or discoidal, with a slender abbreviated caudal pedicle. Head and opercular bones ornamented with tubercles; cheek and gular region covered with small, imbricating, cycloidal scales; teeth more or less rugose and mammillated, those of the vomer in five, and those of the splenial in four regular series. Neural and hæmal arches of axial skeleton of trunk not expanding sufficiently to encircle the notochord. Fin-rays robust, closely arranged, articulated and divided distally. Pelvic fins present; dorsal and anal fins low and fringe-like, except in front where they rise to an elevated point, these two fins arising at about the same point and not extending in advance of the hinder half of the trunk; caudal fin deeply forked, with slender lobes. Scales tuberculated or rugose, covering the whole of the trunk.

Gyrodus macrophthalmus, Agassiz.

1833. *Microdon abdominalis,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 16.
1839–44. *Gyrodus macrophthalmus,* L. Agassiz, *ibid.* vol. ii. pt. ii. pp. 224, 301, pl. lxvii.
1839–44. *Gyrodus rugosus,* L. Agassiz (*ex* Münster MS.), *ibid.* p. 227, pl. lxix. [Nearly complete fish; Palæontological Museum, Munich.]
1842. *Gyrodus mæandrinus,* G. von Münster, Neues Jahrb. p. 45. [Ditto.]
1851. *Gyrodus macrophthalmus,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 28.
1851. *Gyrodus rugosus,* A. Wagner, *ibid.* pp. 29, 45, 56.
1851. *Gyrodus mæandrinus,* A. Wagner, *ibid.* p. 30.
1862. *Gyrodus macrophthalmus,* A. Wagner, *ibid.* vol. ix. p. 336 (in part).
1862. *Gyrodus rugosus,* A. Wagner, *ibid.* vol. ix. p. 337.
1862. *Gyrodus dichactinius,* T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 67, fig. 12. [Nearly complete fish; Teyler Museum, Haarlem.]
1881. *Gyrodus macrophthalmus,* B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 20 (in part).
1887. *Gyrodus macrophthalmus,* K. A. von Zittel, Handb. Palæont. vol. iii. p. 239, fig. 251.

Type. Nearly complete fish; Palæontological Museum, Munich.
The type species, attaining a length of about 0·3. Maximum

depth of trunk not exceeding its length from the scapular arch to the base of the caudal fin, and head with opercular apparatus occupying one-third of the total length exclusive of the caudal fin. [Dentition unsatisfactorily known but] principal teeth exhibiting two crimped rings on crown. Dorsal fin occupying the hinder half of the back, and its maximum elevation equalling about one-fourth of the depth of the trunk at its insertion. Scales towards the dorsal margin conspicuously tuberculated, the others marked with a coarse reticulation.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 1620, P. 3771. Nearly complete fish 0·19 in length, partly in counterpart, wanting the greater part of the dorsal and anal fins; Kelheim. *Egerton and Enniskillen Colls.*

P. 3766. Portion of trunk of a large fish, probably of this species; Kelheim. *Enniskillen Coll.*

P. 1621. Imperfect anterior portion of small fish, probably of this species; Kelheim. *Egerton Coll.*

Gyrodus hexagonus (Blainville).

[Plate XVI. fig. 3.]

1818. *Stromateus hexagonus*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 334.

1833–44. *Microdon hexagonus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 16, pt. ii. pp. 184, 206, pl. lxix. *c.* figs. 4, 5.

1833–44. *Microdon analis*, L. Agassiz, *ibid.* pt. i. p. 16, pt. ii. p. 207, pl. lxix. *c.* fig. 3. [Nearly complete fish; Palæontological Museum, Munich.]

1844. *Gyrodus analis*, L. Agassiz, *ibid.* pt. ii. p. 300.

1851. *Gyrodus hexagonus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. pp. 32, 40, 44, pl. iii. fig. 1.

1851. *Gyrodus lepturus*, A. Wagner, *ibid.* vol. vi. pp. 31, 56. [Imperfect fish; Palæontological Museum, Munich.]

1852. *Gyrodus rugosus*, F. A. Quenstedt (*errore*), Handb. Petrefakt. p. 211, pl. xvi. fig. 1.

1862. *Gyrodus hexagonus*, A. Wagner, *loc. cit.* vol. ix. p. 334.

1881. *Gyrodus macrophthalmus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 20 (in part.)

1887. *Gyrodus hexagonus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 241, fig. 252.

Type. Nearly complete fish and fragment; Palæontological Museum, Munich, and British Museum.

A species, so far as known, closely similar to the type, only differing in the relatively greater protuberance of the abdominal

1906. Gyrodus hexagonus, E. Hennig, Palaeontogr. vol. 7iii. p. 153, pl. xi. text-figs. 5–7; pl. xii. fig. a–

1949. G. h. P. de Saint-Seine N. Arch. Hist. N. St. Lyon 2 p. 125 ff. 52, 53 pl. — f. —

P.1623a. Ribs desc? by A.S. Woodward, Geol. Mag. [6] vol. iv (1917), p. 388.

region, and in the simpler mammillation of the teeth. The maximum depth of the trunk exceeds its length.

A relatively large specimen from the Lithographic Stone of Solenhofen, in the Munich Museum, is regarded by Wagner (*loc. cit.* 1862, p. 335) as probably a distorted example of this species, but in case it happens to prove distinct is provisionally named *G. turgidus*.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 3774. Fragment figured by Agassiz, *loc. cit.* pl. lxix. *c.* fig. 4, as one of the type specimens; Solenhofen. Part of a pectoral fin shows seven basals, and this is evidently not the complete series. A calcified gill-filament exhibits the sparse denticles on one side as in *Mesturus*.

Enniskillen Coll.

37108. Nearly complete fish, partly crushed and fractured, but displaying the relations of the hyomandibular (*hm.*) to the operculum (*op.*) and preoperculum (*p.op.*) as shown in Pl. XVI. fig. 3; Solenhofen. *Häberlein Coll.*

37813. Smaller nearly complete fish, in counterpart; Solenhofen.

Häberlein Coll.

37814. A more imperfect specimen 0·175 in length, in counterpart; Solenhofen. A detached tooth resembles the form described by Agassiz in *G. macrophthalmus*.

Häberlein Coll.

37106. Imperfect fish 0·14 in length, in counterpart; Solenhofen.

Häberlein Coll.

P. 1623, P. 1623 a, P. 2098. Two imperfect small specimens and the scattered remains of a larger fish; Solenhofen. No. P. 1623 shows the feebly serrated abdominal ridge-scales, and no. P. 2098 displays the splenial dentition.

Egerton Coll.

P. 3769, P. 3772–73. Four imperfect examples of the trunk; Kelheim. *Enniskillen Coll.*

Gyrodus frontatus, Agassiz.

[Plate XVI. fig. 2.]

1839–44. *Gyrodus frontatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 226, 301, pl. lxviii.

1840. *Gyrodus gracilis*, G. von Münster, Beitr. Petrefakt. pt. iii. p. 128, pl. viii. fig. 2. [Immature fish; Palæontological Museum, Munich, and Woodwardian Museum, Cambridge.]

1851. *Gyrodus frontatus*, A. Wagner, Abh. k. bay. Akad. Wiss., math. phys. Cl. vol. vi. pp. 29, 55.
1851. *Gyrodus gracilis*="*Microdon hexagonus*," A. Wagner, *ibid.* p. 32.
(?) 1852. *Gyrodus medius*, F. A. Quenstedt, Handb. Petrefakt. p. 211, pl. xvi. fig. 2. [Imperfect fish; Tübingen University Museum.]
1862. *Gyrodus macrophthalmus*, A. Wagner, *ibid.* vol. ix. p. 336 (in part).
1862. *Gyrodus gracilis*, A. Wagner, *ibid.* vol. ix. p. 338.
1881. *Gyrodus macrophthalmus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 20 (in part).
1887. *Gyrodus frontatus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 242, fig. 254.
1893. *Gyrodus frontatus*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. p. 440.

Type. Nearly complete fish; British Museum.

A species resembling *G. hexagonus* in form and proportions, but differing in having the tubercular ornament of the scales, without reticulations, extending over the ventral half of the fish.

The reticular ornament of the scales in *Gyrodus* evidently results from the connection of scattered tubercles by slight ridges. Such a modification may be produced during the growth of the fish, and in that case the so-called *Gyrodus gracilis* is probably the young stage of *G. macrophthalmus* and *G. hexagonus* as well as that of *G. frontatus*.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria, and Ain, France (*Sauvage*).

P. 2096. Type specimen; Kelheim. Little can be seen of the scale-ornament of the ventral half of the fish, but the few traces remaining exhibit scattered tubercles without reticulation. *Egerton Coll.*

22515. Remains of a smaller specimen; Solenhofen. *Purchased*, 1848.

P. 3770. Fish originally about 0·115 in length, wanting the anterior half of the head and the caudal fin; Kelheim. The characteristic expansions on the neural and hæmal spines of the caudal region are conspicuous, as described in the next specimen. Six or seven basal cartilages are observed in the lobe of the pectoral fin, which is covered with thin round scales. *Enniskillen Coll.*

P. 2097. Fine specimen 0·075 in length, shown of the natural size in Pl. XVI. fig. 2; Kelheim. The coarse tubercular ornament of the cranial roof is shown, while the hinder margin of the frontal (*fr.*) and the boundaries of the

1914. *Gyrodes frontalatus*, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 410, pl. lxi. fig. 3.

squamosal (*sq.*) are obscurely indicated. The position of the jaws is shown by remains of the bones and traces both of the prehensile and tritoral teeth. The so-called ossified sclerotic (*scl.*) of the very large eye is also preserved, and seems to exhibit a few minute granulations. A few of the small polygonal tesseræ (*t.*) covering the cheek can be seen immediately below a fragment of the parasphenoid; and the whole of the gular region as far back as the clavicle is invested with similar tesseræ (*t.*) bearing sparse tuberculations. A few traces of the calcified gill-filaments (*g.f.*) remain at the back of the cheek; while the right operculum and preoperculum are exposed from the inner aspect. The operculum (*op.*) is indented on the front margin at its point of suspension from the hyomandibular; the preoperculum (*p.op.*) is thickened at the upper end and exhibits delicate structural fibres radiating from a point at about the middle of its anterior margin. Immediately below the preoperculum are two branchiostegal rays (*br.*), and in front of these appear fragments of bone perhaps of the hyoid arch. The axial skeleton of the trunk is well shown and is noteworthy for the form of the expansions on the neural (*n.*) and hæmal (*h.*) spines of the caudal region. Each expansion is triangular, contracting at the base, widening distally, and almost—though not quite—confined to the anterior margin of the spine. Similar expansions appear to occur at least on the hindermost neural spines of the abdominal region. The lobe of the pectoral fin (*p.*) is distinctly covered with small thin scales, each ornamented with a tubercle; and a cluster of elongated basal cartilages is preserved. The lower expansion of the clavicle (*cl.*) terminates in a point at the ventral border of the fish. The slender pelvic bones (*plv.*) are imperfectly shown at the base of the fragmentary pelvic fins. The median fins exhibit no features worthy of special remark; but just in advance of the origin of the anal the problematical bone (*x*) marking the posterior limit of the abdominal cavity is well displayed. Fine serrations, or acuminate tubercles, are observed on the dorsal and ventral ridge-scales; and the courses of both "lateral lines" are conspicuous. *Egerton Coll.*

P. 1619, P. 3768. More imperfect smaller specimen, in counterpart, displaying the scaly lobe of the pectoral fin and six

of its basal cartilages; Kelheim. The supposed sclerotic seems to exhibit a few sparse and fine granulations as in the last specimen. *Egerton and Enniskillen Colls.*

P. 3768 a. Very small, immature fish, wanting the caudal region; Kelheim. Though much crushed, this specimen is interesting as exhibiting a thickened bar behind the operculum, extending from the normal upper limit of the clavicle to the back of the cranium, thus probably a supraclavicle. Seven basals are preserved in the pectoral fin. *Enniskillen Coll.*

Gyrodus circularis, Agassiz.

1833. *Sphærodus rhomboidalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 15 (undefined).

1834–44. *Gyrodus circularis*, L. Agassiz, Poiss. Foss., Feuill. p. 18 (name only), and vol. ii. pt. ii. p. 300.

1834–44. *Gyrodus punctatissimus*, L. Agassiz, *ibid.* Feuill. p. 18 (name only), and vol. ii. pt. ii. p. 301. [Fragment of fish; Palæontological Museum, Munich.] (=*Microdon gigas*, Agass. MS.)

1834–44. *Gyrodus rhomboidalis*, L. Agassiz, *ibid.* Feuill. p. 18 (name only), and vol. ii. pt. ii. p. 300. [Imperfect fish; Palæontological Museum, Munich.]

1836. *Gyrodus multidens*, G. von Münster, Neues Jahrb. p. 581. [Imperfect head; Palæontological Museum, Munich.]

1845. *Gyrodus umbilicus*, Mandelslohe, Württ. Jahresh. vol. i. p. 153, fig. 2.

1851. *Gyrodus circularis*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 10, pl. i. fig. 1.

1851. *Gyrodus rhomboidalis*, A. Wagner, *ibid.* vol. vi. p. 19, pl. i. fig. 2.

1851. *Gyrodus multidens*, A. Wagner, *ibid.* vol. vi. p. 23, pl. i. figs. 3, 4.

1851. *Gyrodus punctatissimus*, A. Wagner, *ibid.* vol. vi. p. 27.

1855. *Gyrodus umbilicus*, O. Fraas, Württ. Jahresh. vol. xi. p. 100.

1862. *Gyrodus titanius*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 331. [Founded on the type specimen of *G. circularis*, Ag.]

1862. *Gyrodus giganteus*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 80, figs. 13–15. [Nearly complete fish; Teyler Museum, Haarlem.]

1867. *Gyrodus titanius*, F. A. Quenstedt, Handb. Petrefakt. ed. 2, p. 254.

1881. *Gyrodus titanius*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 21.

1887. *Gyrodus titanius*, K. A. von Zittel, Handb. Palæont. vol. iii. pp. 242, 243, figs. 253, 255–257.

Type. Nearly complete fish; Palæontological Museum, Munich.

A large species, attaining a length of about 1·0. Maximum

1830. Gyrodus circularis, K. Weitzel, Abh. Senck. Naturf. Gesell. vol. xlii. p. 89, 12. t-fs.

1830. Gyr. circ. K. Weitzel, 'Natur u. Museum' Frankf. a. M. vol. Lx. pt. 1. (Jan.) p. 24. t-f. 1-4

1906. Gyrodus circularis, E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 173, pl. xxvii. fig. 1.

1896. Gyrodus rhomboidalis, H. Sauvin, Archiv f. Naturgeschichte, vol. i. p. 173, pl. x. fig. 9 [structure of scale].

1906. Gyrodus circularis, E. Hennig, Palaeontogr. vol. Liii. p. 138, pl. x. text-figs. 1–4; pl. xii. fig. 5.

1914. Gyrodus circularis, C. R. Eastman, Mem. Carnegie Inst., vol. vi. p. 410, pl. lxix. fig. 2.

depth of trunk somewhat less than its length from the scapular arch to the base of the caudal fin, and head with opercular apparatus occupying less than one-third of the total length exclusive of the caudal fin. External head-bones ornamented with tuberculations. Dentition closely arranged, with comparatively feeble ornament, soon worn smooth. Vomer with prominent flat-topped median teeth, higher than either of the flanking series, and equalling or exceeding these two series together in width; the inner flanking series somewhat smaller than the outer, of which the teeth are not much elevated. Splenial with principal teeth broader than long, about equalling in width the two flanking series, of which the outermost is much the largest; inner flanking teeth equalling in size those of the innermost series. Dorsal fin occupying the hinder half of the back, and its maximum elevation equalling at least one third of the depth of the trunk at its insertion. Scales towards the dorsal margin ornamented with distant tubercles, the others marked with a delicate reticulation, partly also tuberculated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria and Würtemberg.

49146. Plaster cast of type specimen, the head figured by Wagner, *loc. cit.* 1851, pl. i. fig. 1; Solenhofen, Bavaria.
Purchased, 1878.

37039. A fine specimen 0·68 in length, with imperfect head and paired fins; Solenhofen. *Häberlein Coll.*

37792. Head with imperfect trunk and dorsal fin of a still larger fish; Solenhofen. The mouth is open, and the worn vomerine and splenial dentition has been well extricated from the matrix. Two of the anterior prehensile teeth of the lower jaw and one in the upper jaw are also shown. Some of the small, coarsely tuberculated scales are shown below the hinder part of the mandible. *Häberlein Coll.*

P. 1622. Fragment of squamation; Solenhofen. *Egerton Coll.*

P. 3775. Smaller fragment; Daiting, Bavaria. *Enniskillen Coll.*

35532. Plaster cast of vomerine dentition probably of this species, described and figured by Count von Mandelslohe, *loc. cit.* 1845; Wippingen, near Blaubeuren, Würtemberg.
Purchased, 1859.

It is not improbable that to *Gyrodus circularis* must also be assigned the portions of dentition named *Gyrodus umbilicus* (L.

Agassiz, Poiss. Foss. vol. ii. pt. i. 1833, p. 16, pt. ii. 1844, p. 227, pl. lxix. *a*. figs. 27, 28; F. A. Quenstedt, Handb. Petrefakt. 1852, p. 212, pl. xvi. fig. 3; ? H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais, 1867, p. 41, pl. ii. fig. 12, and Bull. Soc. Géol. France, [3] vol. viii. 1880, p. 526) from the Corallian of Durrheim, Baden, and Schnaitheim, Würtemberg (possibly also Kimmeridgian and Portlandian of N. France), and *Gyrodus jurassicus* (L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1833, p. 16, pt. ii. 1844, p. 229, pl. lxix. *a*. figs. 25, 26; F. A. Quenstedt, Handb. Petrefakt. 1852, p. 212, pl. xvi. fig. 5; K. Fricke, Palæontogr. vol. xxii. 1875, p. 374, pl. xx. figs. 17, 18) from the Kimmeridgian of Soleure, Switzerland, the Corallian and Kimmeridgian of Hanover, and the Corallian of Schnaitheim, Würtemberg. Of the latter the type specimen is in the Museum of Soleure, and the two species are represented in the Collection by the following examples :—

22493*, 22658. Two unworn detached teeth of *G. umbilicus*; Corallian, Schnaitheim. *Purchased*, 1848.

42884. Plaster cast of the type specimen of *G. jurassicus*, being the two associated splenial bones; Kimmeridgian, Soleure. *Van Breda Coll.*

P. 3778. Portion of left splenial dentition, probably the specimen referred to *G. jurassicus* by Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 230; Soleure. *Enniskillen Coll.*

P. 5952. Left splenial dentition of the form referred to *G. jurassicus* by Fricke, *loc. cit.*; Kimmeridgian, Holzen, near Eschershausen, Hanover. *Purchased*, 1889.

P. 3751. Portion of abraded splenial dentition, labelled "*Pycnodus sphærodus*" by Agassiz; Portlandian, Neuchâtel, Switzerland. *Enniskillen Coll.*

Gyrodus cuvieri, Agassiz.

1833–44. *Gyrodus cuvieri*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 16, pt. ii. p. 230, pl. lxix. *a*. figs. 21–23.

1867. *Gyrodus cuvieri*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (Mém. Soc. Acad. Boulogne-sur-Mer, vol. ii.), p. 43, pl. ii. fig. 13.

1875. *Gyrodus ornatissimus*, J. F. Blake, Quart. Journ. Geol. Soc. vol. xxxi. p. 223. [Dentition; British Museum.]

1880. *Gyrodus ornatissimus*, R. Damon, Geol. Weymouth, ed. 2, pl. xi. figs. 1–4, 7–9 (*non* fig. 6).

1880. *Gyrodus cuvieri*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. p. 526.

Gyrodus umbilicus, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), p. 544. pl. xii. figs. 4, 5.
G. umbilicus M.G Mary, 961 Bull. Soc. géol. Normandie 5e 1: 17 ff. 2. (Rouen. Havre.

901. Gyrodus cuvieri, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i, p. 542, pl. xii. figs. 1-3. [Incl. Pycnodus Larteti, Sys.]
930. G. C. J. Thurmann, figs 32, 54 (Blauchin Calc.).
946. G. C. L. Heberger p. 46 ff.
961. G. C. M.G Mary Bull. Soc. géol. Normandy 5e 1: 17 ff.

Type. Mandibular dentition.

A large species known only by the dentition, of which the splenial is indistinguishable from that of *G. circularis*. Vomer with prominent mammillated median teeth, usually not quite equalling the two flanking series in width, and scarcely more elevated than the outermost of the latter, which comprises triangular teeth rising to a conical apex; inner flanking teeth relatively small, low, rounded, and highly ornamented.

The form and degree of ornamentation of the principal teeth on the splenial in this species vary considerably. The immature and smaller specimens are named *G. ornatissimus* by Blake.

Form. & Loc. Lower Kimmeridgian: Dorsetshire, Wiltshire, and Cambridgeshire; N. France.

P. 7456. Fine example of the vomerine dentition, 0·035 in maximum width; Kimmeridge Clay, Poulshot, Wiltshire.

41868, 43026, 43561, 43563, 44085. Five small vomers, the two first comparatively narrow and with very prominent median teeth; Kimmeridge Clay, Weymouth.
Purchased, 1869, –71, –72, –73.

P. 1615, P. 3785. Three similar specimens; Weymouth.
Egerton and Enniskillen Colls.

P. 6151, P. 6166. Four similar specimens, one being figured by Damon, *op. cit.* pl. xi. fig. 4; Weymouth. These and the splenials numbered P. 6168 may be regarded as the type specimens of the so-called *Gyrodus ornatissimus*.
Damon Coll.

P. 1618. Plaster cast of large right splenial; Kimmeridge Clay, Boulogne. *Egerton Coll.*

32746. Somewhat smaller left splenial; Kimmeridge Clay, Ely.
Purchased, 1857.

38553. Imperfect smaller specimen, probably from Ely.
Purchased, 1864

43025. Fine left splenial of moderate size; Kimmeridge Clay, Weymouth. *Purchased*, 1871.

41227, 41963. Portions of right and left splenials, with remarkably smooth principal teeth, and the first specimen exhibiting a supplementary row of small teeth within the outermost series; Weymouth. *Purchased*, 1868, –70.

P. 6168. Two fine right splenials figured by Damon, *op. cit.* pl. xi. figs. 1, 7, and also a left splenial; Weymouth.
Damon Coll.

P. 6164. Imperfect right splenial, figured *ibid.* pl. xvii. fig. 9; said to have been obtained from the Coral Rag, near Sandsfoot, Weymouth, but probably from the Kimmeridge Clay.
Damon Coll.

43559. Small elongated left splenial; Weymouth.
Purchased, 1872.

40638–39, 41176, 44087. Four small right splenials; Weymouth.
Purchased, 1867–68, 1873.

P. 1614. Small right and left splenials, the latter exhibiting an irregular supplementary row of small teeth within the innermost series; Weymouth. *Egerton Coll.*

P. 3786,–a. Small right and left splenials, and a very diminutive specimen of the left side; Weymouth. *Enniskillen Coll.*

P. 346. Very small left splenial, with supplementary inner teeth; Weymouth. *Purchased*, 1881.

P. 6151 a. Pair of very small splenials; Weymouth. *Damon Coll.*

P. 3786 b. Abnormal right splenial, doubtfully of this species, with relatively small principal teeth and two large inner series; Weymouth. *Enniskillen Coll.*

The following specimens do not differ much from the dentition of *Gyrodus cuvieri*:—

40468, 40471–72. Portion of a large vomer, and a large and small splenial, much abraded; Neocomian (derived fossils), Potton, Bedfordshire. *Purchased*, 1867.

40467. Two anterior prehensile teeth; Potton. *Purchased*, 1867.

Gyrodus minor, Agassiz.

1829. "Jaw-bone and teeth of a Reptile," J. Phillips, Geol. Yorkshire, p. 124, pl. ii. fig. 55.
1833–44. *Gyrodus minor*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 16, pt. ii. p. 234, pl. lxix. *a*. fig. 14.
(?) 1844. *Pycnodus minor*, L. Agassiz, *ibid.* pt. ii. p. 200 (name only).

Type. Imperfect splenial dentition.

A species known only by the splenial dentition, which closely resembles that of *G. cuvieri*, but appears to have the teeth more

1901. Gyrodus dubertrei, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i. p. 544. [See p. 213 above.]
1901. ~~Gyrodus~~ subcontiguidens, H. E. Sauvage, loc. cit. p. 545.
1905. Gyrodus subcontiguidens, H. E. Sauvage, Nouv. Catal. Poiss. Form. Second. Boulonnais, p. 13.

P. 8694. Type-specimen, badly pyritised & scarcely recognisable.

Pres.d J. C. Mansel-Pleydell Esq. 1897

strongly ornamented, while the outer end of the larger teeth is raised into a pointed eminence.

Form. & Loc. Neocomian (Speeton Clay): Yorkshire.

P. 1624. Imperfect left splenial; Speeton. *Egerton Coll.*

Gyrodus coccoderma, Egerton.

(?) 1867. *Pycnodus subcontiguidens*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (Mém. Soc. Acad. Boulogne-sur-Mer, vol. ii.), p. 36, pl. ii. figs. 10, 11.

1869. *Gyrodus coccoderma*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxv. p. 383, figs. 3, 4.

1880. *Gyrodus coccoderma*, R. Damon, Geol. Weymouth, ed. 2, Suppl. pl. xi. fig. 5.

(?) 1880. *Mesodon subcontiguidens*, H. E. Sauvage, Bull. Soc. Géol France, [3] vol. viii. p. 528.

Type. Vomer; ~~Museum of Practical Geology, London.~~ Brit. Mus.

A species of large or moderate size, known only by the dentition. Teeth closely arranged and all with a feeble ornamentation, rapidly obliterated by wearing. Vomer with a prominent median series of teeth, at least equalling the two flanking series in width; the outer of the latter obtusely conical, not much elevated and exceeding in size the inner series of flanking teeth, which are round or antero-posteriorly elongated. Splenial differing from that of *G. circularis* and *G. cuvieri* merely in the comparative smoothness of the teeth.

Though the name *G. coccoderma* was originally proposed for some specifically indeterminable scales, it has gradually become applied to the dentition above described, and the vomer provisionally assigned to this species by Egerton may thus be regarded as the type specimen.

Form. & Loc. Kimmeridgian: Dorsetshire and Cambridgeshire; N. France.

P. 6747. Fine large vomer 0·028 in maximum width, with little-worn dentition; Kimmeridge Clay, Weymouth.
Purchased, 1892.

P. 6167. Two somewhat smaller specimens, one figured by Damon, *op. cit.* pl. xi. fig. 5; Weymouth. *Damon Coll.*

43560, 43562. Portion of similar vomer, and a smaller specimen; Weymouth. *Purchased*, 1872.

40637, 41175, P. 3785 a. Three fine much-worn vomers; Weymouth. *Purchased*, 1867–68 *and Enniskillen Coll.*

41392, 41870–73. Four fragments and one small much-worn vomer; Weymouth. *Purchased*, 1869.

P. 3787. Portion of large vomer with much-worn teeth; Kimmeridge Clay, Ely. *Enniskillen Coll.*

32549. Dentition of large left splenial; Kimmeridge Clay, Havre. *Tesson Coll.*

41391, 44088. Two examples of the left splenial; Weymouth. *Purchased*, 1869, 1873.

P. 1614 a. Two right splenials; Weymouth. *Egerton Coll.*

P. 3786 c. Right and left splenials with very irregular principal teeth, and the former showing a supplementary inner series of minute teeth; Weymouth. *Enniskillen Coll.*

Gyrodus planidens, sp. nov.

1880. *Gyrodus ornatissimus*, R. Damon, Geol. Weymouth, ed. 2, Suppl. pl. xi. fig. 6 (*errore*).

Type. Vomer; British Museum.

A species of moderate or small size, known only by the vomer, which bears highly ornamented and widely spaced teeth. Teeth of median series on the vomer much less in width than the two flanking series, neither the median nor the outermost teeth much more elevated than those of the inner flanking series, which are, however, the smallest.

The splenial dentition of this species is either unknown or indistinguishable from that of *G. cuvieri*.

Form. & Loc. Kimmeridgian: Dorsetshire.

P. 6166 a. Type specimen figured by Damon, *loc. cit.*; Kimmeridge Clay, Weymouth. *Damon Coll.*

44086. Vomer; Weymouth. *Purchased*, 1873.

P. 3785 b. Another fine vomer; Weymouth. *Enniskillen Coll.*

P. 1615 a. Imperfect vomer; Weymouth. *Egerton Coll.*

41393. Two small specimens; Weymouth. *Purchased*, 1869.

Gyrodus murchisoni, Mantell.

1844. *Gyrodus murchisoni*, G. A. Mantell, Medals of Creation, p. 643, fig. 134.

Type. Portion of vomer; British Museum.

A large species known only by the vomerine dentition. Teeth of

G. atherfieldensis, n.s.° Aptian.
'G.' bennetti, n.s.° Chalk.

Polygyrodes n.g. E.T. White 1927. Ann. & Mag. N.H. (9) vol. xx p. 191. Genotype P. cretaceus. Ag.

1909-12. Gyrodus(?) cretaceus, A.S. Woodward, Fos. Fishes English Chalk (Pal. Soc.), pp. 167, 251, pl. xxxv. figs. 5-7; pl. 7iv. fig. 5.
1933. Gyrodus (?) cretaceus R. Sarra,° p29 (Basilicata).
1943. G. aff. cretaceus Reading & Edwards, Bull. y. Dir. A.O.F. p. 38 pl. ii. f. 8-9. (W. Cat. Niger).

39048. Des? & fig? A.S.W. 1909, p. 167, pl. xxxv. fig. 5.

49802. Noticed A.S.W. 1909, p. 168.
P.6852. Des? & fig? A.S.W. 1909, p. 168, pl. xxxv. fig. 6.

49804. Vomerine dentition of young, des? & fig? A.S.W. 1909, p. 168, pl. xxxv. fig. 7; Southerham, Lewes. Capron Coll.
P.11157. Splenials with dentition, des? & fig? A.S. Woodward, 1912, p. 251, pl. 7iv. fig. 5; zone of Ter. gracilis, Cuxton, Kent. Purchased from F.G. Hutchinson, 1913.

vomer depressed and flattened, conspicuously rugose, those of the median series not very prominent and at least equalling in width the two flanking series.

Form. & Loc. Jurassic: Russia.

P. 3782. Type specimen described and figured by Mantell, *loc. cit.*; from Rjeff, on the Volga. The crowns of the outermost series of teeth are all broken away, and only one of the median series remains. *Enniskillen Coll.*

Poly Gyrodus (?) cretaceus, (Agassiz.)

1833–39. *Sphærodus mammillaris*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 15 (in part), pl. lxxiii. figs. 1, 2. [Teeth.]
1839–44. *Gyrodus cretaceus*, L. Agassiz, *ibid.* vol. ii. pt. ii. p. 233, pl. lxix. *a.* fig. 13.
1840. *Gyrodus cretaceus*, R. Owen, Odontography, p. 72.
1844. *Gyrodus mammillaris*, L. Agassiz, *ibid.* vol. ii. pt. ii. p. 236.
1844. *Pycnodus marginalis*, L. Agassiz, *ibid.* vol. ii. pt. ii. p. 199. [Tooth.]
1850. *Gyrodus cretaceus*, F. Dixon, Geol. Sussex, p. 370, pl. xxx. fig. 15.
1850. *Gyrodus conicus*, F. Dixon, *ibid.* p. 370, pl. xxxii. fig. 8.
1888. *Gyrodus cretaceus*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 308.

Type. Portion of vomerine dentition.

A large species of uncertain genus, probably not *Gyrodus*, but known only by fragmentary dentition. Dental crowns much elevated, obtusely acuminate, and coarsely rugose; those of the median and outer paired series on the vomer longer than broad, about equal in size; teeth of inner paired series on this bone relatively small and irregularly subdivided.

Form. & Loc. Senonian: Sussex and Surrey.

39048. Vomerine dentition figured in Dixon's Geol. Sussex, pl. xxx. fig. 15; Chalk, Lewes. *Bowerbank Coll.*

49802. Portion of vomerine dentition; Upper Chalk, St. Catherine's Hill Pit, near Guildford. *Capron Coll.*

P. 6852. Portion apparently of splenial dentition, showing principal series of teeth; Chalk, Upper Warlingham, near Croydon. *Presented by G. E. Dibley, Esq.*, 1893.

The following specimen seems to belong to *Gyrodus*, but is not specifically determined:—

43285. Portion of relatively broad vomer, with well-spaced teeth remarkably uniform in size (Pl. XVII. fig. 5); Kimmeridge

Clay, Weymouth. The teeth of the median and inner lateral series only are preserved, and each is slightly broader than long, with a cingulum at the base of the crown which is raised into a comparatively trenchant edge. *Purchased*, 1871.

The following species have also been imperfectly defined, chiefly upon the evidence of the dentition, but are not represented in the Collection :—

Gyrodus contiguidens: *Pycnodus* (*Typodus*) *contiguidens*, F. J. Pictet, Rept. et Poiss. Foss. Jura Neuchâtel (1860), p. 69, pl. xvi. fig. 1; (?) J. Cornuel, Bull. Soc. Géol. France, [3] vol. xi. (1883), p. 23, pl. i. figs. 4, 5.—Kimmeridgian; Neuchâtel. (?) Neocomian; Haute Marne. [Vomer; Neuchâtel Museum.]

Gyrodus fabrei, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. vi. (1878), p. 629, pl. xi. fig. 2.—Lias; Nancy, France. [Left splenial.]

Gyrodus fortisi, G. G. Gemmellaro, Studi Paleont. Fauna Calc. *Terebratula janitor* N. Sicilia, pt. i. (1868), p. 6, pl. ii. figs. 15–31.—Tithonian; Favara, Villabate, N. Sicily. [Detached teeth; Geological Museum, University of Palermo.]

Gyrodus goweri, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxv. (1869), p. 379, figs. 1, 2.—Middle Jurassic; Culgower, Sutherland. [Trunk.]

Gyrodus imitator: *Pycnodus imitator*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 612, pl. xi. fig. 11, and *ibid.* vol. viii. (1880), p. 157, pl. iii. figs. 18, 19. *Cosmodus imitator*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. (1879), pt. ii. p. 49.—Neocomian; Wassy, Haute Marne, and Ville-sur-Saulx, Meuse, France. [Imperfect splenial.]

Gyrodus (?) *lævior*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 233, pl. lxix. *a*. fig. 12.—Form. & loc. unknown[1]. [Right splenial; Paris Museum Nat. Hist.]

Gyrodus larteti: *Pycnodus larteti*, H. E. Sauvage, Catal. Poiss. Form. Second. Boulonnais (Mém. Soc. Acad. Boulogne-sur-Mer, vol. ii. 1867), p. 33, pl. ii. fig. 1, and Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 527.—Portlandian; N. France. [Imperfect splenials; Boulogne Museum.]

[1] An isolated tooth in the Enniskillen Collection (**P. 3783**), said to have been obtained from the London Clay of Sheppey, is labelled "*Gyrodus lævior*, Agass." by Agassiz.

Gyrodus sp., F. Priem, Ann. Paléont. vol. vi (1911), p. 16, text-fig. 4. — Turonian; Vitry-le-François, Marne. [Incisor.]

Gyrodus carthailhaci, F. Priem, Bull. Soc. Géol. France [4] vol. xvi (1916), p. 288, pl. viii. fig. 2. — Uppermost (?) Jurassic; near Bergerac, Dordogne. [Left splenial; Nat. Mus. Nat. Hist. Paris.]

P. 10772. Counterpart of type of Gyrodus gouveri. Pres? by R. Marcus Gunn, Esq., 1909.

Gyrodus larteti, M. Leriche, Ann. Soc. Géol. Nord, vol. xxx (1901), p. 163, pl. v. fig. 17. = young of G. cuvieri acc. to W. E. Sauvage, Nouv. Catal. Poiss. Foss. Second. Boulonnais (1905), p. 13. Fig? Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), pl. xii. fig. 3.

Gyrodus oltis, H. E. Sauvage.

Gyrodus sculptus includes disparilis, imitator, Cotteaui, contiguidens, asperulus, according to M. Leriche, Bull. Soc. Géol. France [4] vol. x (1910), p. 461.

Tibetodus (?) gyrodoides gen. (?) et sp. nov.
C. C. Young & H. T. Liu 1954 Acad. Pal. Sinica 2 1, p 95-
4 figs. [Vomer, dent. U. Jaw, pr. h. Cret. Tibet].

Gyrodus milicum, J. Henry, Mém. Soc. d'Émulat. Doubs [4] vol. x (1876), p. 412, pl. ii. fig. 13. — Rhætic; Grozon. [? Colobodus.]

Gyrodus platurus, L. Agassiz, *op. cit.* Feuill. (1834), p. 16 (name only); A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1862), p. 336. *Microdon platurus*, L. Agassiz, *op. cit.* vol. ii. pt. i. (1833), p. 16. *Gyrodus truncatus*, A. Wagner, *loc. cit.* vol. vi. (1851), p. 46.—Lower Kimmeridgian (Lithographic Stone); Bavaria. [Nearly complete fish; Palæontological Museum, Munich.]

Gyrodus punctatus, L. Agassiz, *op. cit.* vol. ii. pt. ii. (1844), p. 231, pl. lxix. *a*. fig. 24; A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. xii. (1893), p. 400, pl. xviii. figs. 2–4. (?) *Pycnodus umbonatus*, L. Agassiz, *loc. cit.* pt. i. (1833), p. 16, pt. ii. (1844), p. 194, pl. lxxii. *a*. figs. 1, 3, 4 (*non* fig. 2).—Corallian; Malton, Yorkshire. [Vomer; York Museum.] In Inst. Geol. Univ. Neuchâtel

Gyrodus sculptus: *Pycnodus sculptus*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 611, pl. xi. figs. 8–10, and *ibid.* vol. viii. (1880), p. 157, pl. iii. figs. 20, 21. *Cosmodus sculptus*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 49.—Neocomian; Wassy, Haute Marne, and Soulaines, Aube, France. [Imperfect splenials.]

Gyrodus (?) *schusteri*, F. A. Roemer, Verstein. Norddeutsch. Oolithengeb., Nachtr. (1839), p. 54.—Purbeckian; Salzburg, Osterwald.

An imperfect vomer, with widely-spaced smooth teeth, apparently referable to a large species of *Gyrodus*, is described by Egerton from the Kimmeridge Clay of Kimmeridge, Dorsetshire, and wrongly named *Sphærodus gigas* (Quart. Journ. Geol. Soc. vol. xxv. 1869, p. 385, woodc. fig. 5).

Some prehensile front teeth from the Kimmeridgian of Berne, Switzerland, apparently also of *Gyrodus*, are erroneously referred to *Capitodus* under the name of *C. gresslyi* by J. Thurmann, Nouv. Mém. Soc. Helv. Sci. Nat. vol. xviii. (1864), p. 431, pl. lxi. fig. 21.

The following names have also been given to indeterminable detached teeth:—

Gyrodus dixoni, W. A. Ooster, Protozoe Helvetica, vol. ii. (1870), p. 46, pl. ix. fig. 7. Figure by F. Dixon, Geol. Sussex (1850), pl. xxxii.* fig. 6.—Chalk; Sussex and Bernese Alps.

Gyrodus ellipticus, E. von Eichwald, Leth. Rossica, vol. ii. (1868), p. 1211, pl. xxxviii. fig. 11.—Neocomian; Biassala, Crimea.

Gyrodus muensteri, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 235, pl. lxix. *a*. fig. 17; A. E. Reuss, Verstein. böhm. Kreideform. pt. i. (1845), p. 9, pl. iv. figs. 57–60.—Cenomanian; Bavaria and Bohemia.

Gyrodus navicularis, T. C. Winkler, Archiv. Musée Teyler, vol. iv. (1874), p. 30, pl. ii. figs. 19–21.—Middle Eocene (Bruxellian); Uccle, Brussels. [Not Pycnodont.]

Gyrodus quadratus, A. E. Reuss, Verstein. böhm. Kreideform. pt. i. (1845), p. 9, pl. iv. figs. 56–61.—Cenomanian; Bohemia.

Gyrodus rugulosus, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 235, pl. lxix. *a*. fig. 16.—Cenomanian; Regensburg, Bavaria. [Royal Bohemian Museum, Prague.]

Gyrodus runcinatus, L. Agassiz, *ibid.* pt. i. (1833), p. 16, pt. ii. (1844), p. 236, pl. lxix. *a*. fig. 19.—Form. and loc. unknown. [Stuttgart Museum.]

Gyrodus wannerius, A. Dollfuss, Faune Kimm. Cap De la Hève, (1863), p. 35, pl. i. figs. 17, 18 (name said to have been originally given by Lesueur to a jaw much resembling *G. jurassicus*, figured on a rare plate "Vues et coupes de la Hève," 1843).—Kimmeridgian; Normandy.

Genus **STEMMATODUS**, Heckel.

[Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. 1856, p. 202.]

Trunk deeply fusiform, not produced at the caudal pedicle. Head and opercular bones tuberculated; teeth with an apical indent surrounded by a crenulated margin; vomerine teeth in five longitudinal series, and splenial teeth in three series. Neural and hæmal arches of axial skeleton of trunk not expanding sufficiently to encircle the notochord. Fin-rays delicate, spaced, and articulated in the dorsal and anal fins; stouter, more closely articulated, and divided distally in the caudal fin. Pelvic fins present; dorsal and anal fins low, acuminate in front, fringe-like behind, the former occupying at least the hinder half of the back, and the latter somewhat shorter, arising more posteriorly; caudal fin with straight or slightly excavated hinder margin. Scales covering only the anterior half of the trunk in advance of the median fins.

Stemmatodus rhombus (Agassiz).

1839–44. *Pycnodus rhombus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 188, pl. lxxii. figs. 5–7.

1856. *Stemmatodus rhombus*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 202.

1856. *Stemmatodus rhomboides*, J. J. Heckel, *ibid.* p. 205, pl. ii. figs. 9–11. [Nearly complete fish; Royal Bohemian Museum, Prague.]

= *Pseudosphaerodon navicularis*, Leriche. Part IV. p. 552.

—— 1814. S.B. Akad. Wiss. Wien. Math. naturw. Kl. XXI. 455.

1810. *Sparus melanurus*, F. Cavolini (errore), Apenninorum montium Campaniam ambientium Physica disquisitio. pl. i. fig. 2; pl. ii. fig. 2c.

1962. *Stemmatodus rhombus*, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. [3] vol. XVII. p. ~~219~~, pl V. fig. ~~4,5~~ 2,3, text-fig. 9, 10a.

Cenomanian / Bassani & D'Erasmo, 1912).

P.1671 = Coelodus costae : shows the supratemporal vacuity.

Glossodus, O. G. Costa, Neues Jahrb. 1851 p. 184.
~~Coelodus~~

C. sp. cenoman. Barbaije, Leriche 1935 b. p. 32, pl. i. 7. 4, 11
C. sp. Cenoman, Lisbon G. Zbyszewski & M. F. d'Almeida 1951 Com. Serv. Geol. Portugal 32 (1), p. 66 & 67.
C. plethodon s. a. Reinhardt & Soleand 1943. Bull. Dir. Mines A.O.F. p. 36, pl. 5 fig. 4. Gret, Niger.

Type. Nearly complete fish.

The type species, attaining a length of about 0·08. Maximum depth of trunk about equal to its length from the scapular arch to the base of the caudal fin, and head with opercular apparatus occupying somewhat less than one-third of the total length of the fish; arched dorsal contour sharply bent just in advance of the fin. External bones closely but coarsely tuberculated, in part reticulated; all the teeth finely crenulated round the margin of the coronal indentation. Dorsal fin comprising about 36 rays, and its maximum elevation not equalling more than one-fourth of the depth of the trunk at its insertion; anal fin with about 30 rays. Ridge-scales finely serrated.

Form. & Loc. Upper Jurassic: S. Italy.

18600. Slab with two typical specimens; Torre d'Orlando, near Naples. *Purchased*, 1844.

23152. Slab with three specimens, in counterpart; Torre d'Orlando. *Presented by Major Macdonald*, 1849.

43451. Slab with two specimens, showing part of the dentition; Torre d'Orlando.
Presented by Kenneth Murchison, Esq., 1872.

39775. Small fish showing part of the dentition; Torre d'Orlando. *Purchased*, 1862.

P. 1670–73. Four specimens; Torre d'Orlando. *Egerton Coll.*

P. 7457. A comparatively elongated fish; Torre d'Orlando.

Genus **CŒLODUS,** Heckel[1].

[Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. 1856, p. 202.]

Syn. *Glossodus,* O. G. Costa, Atti Accad. Pontan. vol. vii. 1853, p. 26.
Cosmodus, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. 1879, p. 48.

Trunk very deeply fusiform, with slender abbreviated caudal pedicle. Head and opercular bones externally rugose and punctate; most of the teeth exhibiting an apical indent with crenulated border; oral surface of vomer strongly convex from side to side, with teeth in five longitudinal series; splenial dentition comprising three series of teeth with long axes directly transverse, sometimes

[1] This name having gained universal acceptance, we adopt it, notwithstanding its preoccupation among Mammalia by *Cœlodon*, Lund, 1839.

supplemented within by a small row, and all the outer teeth showing frequent tendency to irregular subdivision. Neural and hæmal arches of axial skeleton of trunk not expanding sufficiently to encircle the notochord. Fin-rays robust, closely articulated, and much divided distally. Pelvic fins present; dorsal and anal fins high and acuminate in front, low and fringe-like behind, the former occupying at least the hinder half of the back and the latter somewhat shorter, arising more posteriorly; caudal fin deeply forked, with a convexity in the middle. Scales ornamented with reticulating rugæ and punctations, and occupying only the anterior half of the trunk in advance of the median fins.

Cœlodus saturnus, Heckel.

1856. *Cœlodus saturnus*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 207, pls. iii., iv.
1863. *Cœlodus saturnus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. xlviii. pt. i. p. 138.
1867. *Cœlodus saturnus*, R. Kner, *ibid.* vol. lvi. pt. i. p. 198.

Type. Nearly complete fish.

The type species, attaining a length of about 0·5. Maximum depth of the trunk equalling about one-half, and length of head with opercular apparatus one-quarter of the total length of the fish. Vertebral axis at origin of dorsal fin midway between the dorsal and ventral borders of the fish. Teeth of median series on the vomer about twice as broad as long, those of the first lateral series little elongated and obliquely set, those of the outer series smaller and round or antero-posteriorly elongated. Teeth of the principal (inner) series on the splenial bone attaining a breadth about five times as great as their length, all nearly destitute of apical indent; those of the next outer series half as large, and about three times as broad as long; those of the outermost series comparatively small and round. Dorsal fin with 65 rays, occupying more than half of the back; anal fin with 48 rays arising more posteriorly. 14–15 vertical series of scales.

Form. & Loc. Cretaceous: Goriansk, Istria. Perhaps?

Not represented in the Collection.

Cœlodus suillus, Heckel.

1856. *Cœlodus suillus*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 217, pls. vi., vii.
1882. *Cœlodus suillus*, F. Bassani, *ibid.* vol. xlv. p. 201.

Type. Fish, wanting caudal fin; Museum of Gymnasium, Zara.

C. crassus d.n. Maastrichtian Congo Basin Dartevelle & Casier 1949 p. 208 pl. xvii f. 6.

C. zambrensis d.n. ? Maastrichtian Congo Basin Dartevelle & Casier 1949 p. 209 pl. xvii f. 2.

1895. C. S. Kramb. Gorj. Djela Jugosl. Ak. 16 p. 31. ff.
1937. Coelodus salinus, Sarasin; p. 55, f. 1. (Italy).
1946. " " d'Erasmo p. 11 ff. 2 3. (4).
(Restor.)
1951. C. S. G. Zbyszewski & O.M. D'Almeida Com. Serv. Geol. Portugal 32, 1: 86 pl. 1. Cenomanian Lisbon

1895. C. S. Kramb. Gorj. Djela Jugoslav. Akad. 16. p. 28 pl. vi. f. 5.

Coelodes jordani s.n. Pola Saint-Seine 1949, N. Arch Mus. N. H. Lyon 2 p. 133, ff. 59-60 pl. xii f. D, xiii f. B. Minnor. Cerin. Fish Mus. N.H. Lyons.

An imperfectly defined species, somewhat smaller than the type, of nearly similar proportions, but apparently differing in its relatively smaller head. Vertebral axis at origin of dorsal fin slightly above the middle point between the dorsal and ventral borders of the fish. 11 vertical series of scales, each completed at the ventral margin with a coarsely serrated ridge-scale.

Form. & Loc. Upper Cretaceous: Island of Lesina, Dalmatia [1].

P. 5947. Small specimen 0·115 in length, the hinder portion obscured by a thin film of matrix. *Purchased*, 1889.

Cœlodus rosthorni, Heckel.

1856. *Cœlodus rosthornii*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 213, pl. v.

Type. Hinder two-thirds of fish; Rosthorn Collection, Klagenfurt.

An imperfectly defined species, attaining a length of at least 0·5, remarkable for its much elongated trunk and the great interdigitating expansion of its neural and hæmal arches. Vertebral axis at origin of dorsal fin slightly above the middle point between the dorsal and ventral borders of the fish. Dorsal fin with 51, and anal with 41 rays.

Form. & Loc. Upper Cretaceous: Comen, Istria.

Not represented in the Collection.

Cœlodus grandis (Costa).

1853. *Pycnodus grandis*, O. G. Costa, Atti Accad. Pontan. vol. vii. p. 20, pl. iii. figs. 1–3, 5.

(?) 1853. *Pycnodus achillis*, O. G. Costa, *ibid.* p. 23, pl. iii. figs. 7–10. [Splenial dentition.]

1856. *Cœlodus grandis*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 203.

1882. *Cœlodus grandis*, F. Bassani, *ibid.* vol. xlv. p. 232.

Type. Nearly complete fish.

A small, imperfectly-known, deep-bodied species, the maximum depth of the trunk considerably exceeding its length from the pectoral arch to the base of the caudal fin; head with opercular apparatus occupying about one-quarter of the total length of the fish. Vertebral axis at origin of dorsal fin very slightly above the

[1] A fish from the Cretaceous of Mt. S. Agata, near Gradisca, Istria, is also described as closely related to this species by F. Bassani, Jahrb. k. k. geol. Reichsanst. vol. xxxiv. (1884), p. 405, pl. ix. fig. 3.

middle point between the dorsal and ventral borders of the fish. 11 vertical series of scales.

The splenial dentition named *Pycnodus achillis* is characterized thus:—Teeth of principal series at least twice as broad as long, exceeding in width the two outer series and irregularly bordered within by one row of small round teeth; those of the inner flanking series also at least twice as broad as long, sometimes subdivided; those of the outermost series small and round.

Form. & Loc. Cretaceous: Pietraroja, Naples.

Not represented in the Collection.

Cœlodus costæ, Heckel.

1850. *Pycnodus rhombus,* O. G. Costa (*errore*), Atti Accad. Pontan. vol. v. p. 332, pl. iv. fig. 8 (*non* pl. v. fig. 1).

1856. *Cœlodus costæ,* J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 203.

Type. Nearly complete fish.

A small species attaining a length of about 0·105. Maximum depth of the trunk much exceeding one-half, and length of head with opercular apparatus equalling one-third of the total length of the fish. Teeth of principal (inner) series on splenial about three times as broad as long, indented on the apex and with crenulated margin. Dorsal fin with about 46 rays, occupying more than half of the back; anal fin with about 35 rays, arising more posteriorly. 10–12 vertical series of scales.

Form. & Loc. Upper Jurassic: S. Italy.

P. 1671 a. Small specimen displaying median fins and a few of the splenial teeth; Torre d'Orlando, near Naples.

Egerton Coll.

P. 4394. More imperfectly preserved fish, 0·105 in length, also showing some of the teeth; Torre d'Orlando.

Enniskillen Coll.

Cœlodus mantelli (Agassiz).

1827. "Palates of an unknown fish," G. A. Mantell, Foss. Tilgate Forest, p. 58, pl. xvii. figs. 26, 27.

1833. *Pycnodus microdon,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17.

1839–44. *Pycnodus mantellii,* L. Agassiz, *ibid.* pt. ii. p. 196, pl. lxxii. *a.* figs. 6–14.

1839–44. *Gyrodus mantellii,* L. Agassiz, *ibid.* pt. ii. p. 234, pl. lxix. *a.* fig. 18. [Splenial; British Museum.]

C. gridelli S.A Cretac. Trieste, G. D'Erasmo, an. Mus. Civ. Stor. Nat. Trieste (8) 4 p.84 ff. 1-5, pl.1: [Fishes: Trieste].

1946. C. costai D'Erasmo p.17 ff. 4,5

1926. Coelodus costai, R. Sarra, Riv. Ital. Pal. XXXII p. 69 (Cretac. Basilicata).

1911. Coelodus grandis, G. D'Erasmo, Atti Soc. Ital. Sci. (Napoli 1910), p. 798.

1912. Coelodus costai, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. [3] vol. XVII. p. 224, pl. V. f. 4, 5; text-figs. 1, 2.

1914. Coelodus costai, G. D'Erasmo, Paleont. Italica, vol. XX. p. 64, pl. VI. f. 2, 3; pl. VII.

1918. Coelodus costae, A. S. Woodward, Fos. Fishes Weald & Purb. Form. (Pal. Soc. 1916), p. 65, text-fig. 24. [Restoration.]

1922. Coelodus costai, G. D'Erasmo, Rend. R. Accad. Sci. Napoli, no. , p. 3, pl. I. fig. 1. [Cenom.; Alessano, Prov. Lecce.] = Cenomanian (Bassani & D'Erasmo).

P. 1671. Transfer from Stemmatodus rhombus. This and P. 1671 a show supratemporal vacuity noticed by A.S.W. Geol. Mag. [6] vol. IV (1917), p. 387.

1918. Coelodus mantelli, A. S. Woodward, Trans. Fisher Weald. & Purb. Form. (Pal. Soc. 1916), p. 66, pl. xv. figs. 6–11.

2709. Des? & fig? A.S.W. loc. cit. 1918, p. 67, pl. xv. fig. 8.
28415a. Des? & fig? A.S.W. loc. cit. 1918, p. 67, pl. xv. fig. 9.
28415b. Des? & fig? A.S.W. loc. cit. 1918, p. 67, pl. xv. fig. 10.
28417. Des? & fig? A.S.W. loc. cit. 1918, p. 66, pl. xv. fig. 6.

1853. *Glossodus mantellii*, O. G. Costa, Atti Accad. Pontan. vol. vii. p. 28.

1856. *Cœlodus mantelli*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 203.

Type. Jaws; British Museum.

A species of small or moderate size, known only by the dentition. Teeth of median series on vomer somewhat more than twice as broad as long, with a concave posterior margin, sometimes mesially constricted; teeth of two lateral series nearly equal in size, slightly elongated antero-posteriorly, and their width together not equalling that of the median series. Teeth of principal series on the splenial bone not more than twice as broad as long, scarcely equalling in width the two outer series, of which the innermost is nearly twice as wide as the outermost; a row within the principal series very rarely represented even by scattered small teeth. All the teeth, when unworn, with a deep apical pit, not crenulated on the margin.

Form. & Loc. Wealden: Sussex. Variety in Purbeckian: Dorsetshire and N. Germany [1].

2690, 2698, 2709, 28415, 28417. Series of eight type specimens described and figured by Agassiz, *tom. cit.* pl. lxxii. *a.* figs. 6–9, 11–14, wanting the original of fig. 10; Wealden, Tilgate Forest, Sussex. *Mantell Coll.*

2700, 2707, 28416. Three specimens of the vomerine dentition, the first large and imperfect; Tilgate Forest. *Mantell Coll.*

P. 4392. Vomerine dentition, wanting outermost series of teeth; Tilgate Forest. *Enniskillen Coll.*

49115. Two imperfect abraded specimens; Wealden, Tunbridge Wells. *Mrs. Smith's Coll.*

[1] A form of dentition very closely resembling that of *Cœlodus mantelli*, from the Portlandian of Dept. Meuse, France, is also described by J. Cornuel, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 151, pl. iii. figs. 1–15. He names two varieties of the vomerine dentition, "*Pycnodus mantelli*, var. *brevis*," and "var. *stricta*." Other doubtful portions of vomers from the Neocomian of Haute Marne, France, are described by the same author, *ibid.* vol. v. (1877), p. 616, pl. xi. figs. 23–25, and F. J. Pictet, Mém. Soc. Linn. Normandie, vol. xvi. (1872), no. i. p. 18, pl. i. fig. 4. The species has also been recorded from the Wealden and Purbeck of North Germany on the evidence of splenials and vomers with widely spaced dentition and with the principal teeth much more transversely extended than in the typical English jaw (W. Dunker, Norddeutsch. Wealdenbild. 1846, p. 65, pl. xv. figs. 19, 20, and C. Struckmann, Wealdenbild. Hannover, 1880, p. 89, pl. iii. figs. 6, 7).

28415 a. Left splenial, the type specimen of the so-called *Gyrodus mantelli*, Agassiz, *loc. cit.*; Tilgate Forest. *Mantell Coll.*

28415 b. Two left splenials; Tilgate Forest. *Mantell Coll.*

39215. Imperfect small right splenial dentition; Wealden, ~~Battle~~, Sussex. *Bowerbank Coll.*

Brook, Isle of Wight

P. 1629. Right splenial dentition showing irregular subdivision of outermost series of teeth; Tilgate Forest. *Egerton Coll.*

P. 3763. Right splenial with well-preserved teeth, showing the base of a single minute tooth within the principal series; Wealden, near Hastings. *Enniskillen Coll.*

P. 3755. Left splenial dentition, probably of this species; Purbeck Beds, Swanage. The principal teeth and a single minute inner tooth are exhibited only by their bases; the outermost teeth are more robust than is usual in the species. *Enniskillen Coll.*

21349. Two more imperfect examples of similar dentition; Swanage. *Purchased*, 1847.

P. 7445. Similar right splenial; Purbeckian (Serpulit), Thüsterberg, Hanover. *Purchased*, 1895.

Cœlodus gyrodoides, Egerton.

1877. *Cœlodus gyrodoides*, Sir P. Egerton, Geol. Mag. [2] vol. iv. p. 52, pl. iv. fig. 3.

Type. Vomerine dentition; British Museum.

A large species, known only by the vomerine dentition, which measures 0·04 in maximum width. Teeth of median series about twice as broad as long, with deeply concave posterior margin; teeth of the two lateral series nearly equal in size, slightly elongated transversely, and their width together exceeding that of the median series. All unworn teeth with apical indent, slightly crimped.

Form. & Loc. Upper Cretaceous: Dorsetshire.

P. 3762. Type specimen, shown of three-quarters the natural size in the accompanying fig. 31; Upper Greensand, Pinney Bay, near Lyme Regis. *Enniskillen Coll.*

Cœlodus ellipticus, Egerton.

1877. *Cœlodus ellipticus*, Sir P. Egerton, Geol. Mag. [2] vol. iv. p. 49, pl. iii. fig. 1.

Type. Right splenial dentition; British Museum.

A large species known only by the splenial dentition. Teeth of

39215 = Coelodus multidens. See opposite p. 255.

P.3763. Des? & fig? A.S.W. loc. cit. 1918, p. 67, pl. xv. fig. 7.

P.11903. Left splenial, des? & fig? A.S.W. loc. cit. 1918, p. 67, pl. xv. fig. 11; U. Purbeckian, Netherfield, Sussex. Pres? by Revs. P. Teilhard & F. Pelletier, S.J., 1912.

= mut. of C. mantelli. G.A.B.

Coelodus multidens, A.S.W.

1918. Coelodus multidens, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 67, pl. xv. figs. 12, 13.

Type. Right splenial, with dentition; M.P.G.

Form. & Loc. Wealden: Kent, Sussex, Isle of Wight.

39215. Portion of right splenial, des.d & fig.d l.c. 1918, p. 68, pl. xv. fig. 13; Battle, Sussex. Bowerbank Coll.

Coelodus solerí s.n. Cetac. Catalonia, J. Bauza 1948 Estud. geol. inst. Mallada 8 241 1 pl. (rms. dentition)
C. solei (sic) J. Bataller 1959 Bol. Inst. geol. Esp. 70 : 72 ff. 53

Coelodus hirudo (Agassiz).

1839. Acrodus hirudo, L. Agassiz, Poiss. Foss. vol. iii. p. 148, pl. xxii. f. 27.
1887. " " A.S. Woodward, Geol. Mag. [3] vol. iv. p. 102.
1889. " " A.S. Woodward, Cahal. pt. i. p. 296, pl. xiii. fig. 9.
1918. Coelodus hirudo, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 68, pl. xv. figs. 14–18.

Type. Worn tooth; British Museum.
Form. & Loc. Wealden: Sussex.

2706. Type specimen des.d & fig.d by Agassiz, 1839; prepared & afterwards re-des.d & fig.d by A.S. Woodward, 1918; Tilgate Forest. Mantell Coll.

P.4994. Tooth fig.d A.S.W. 1889; Telham. Pres.d G.E. Lee, Esq. 1885.

P.11900. Ten teeth, one des.d & fig.d A.S.W. 1918, p. 69, pl. xv. f. 16; Wadhurst Clay, Hastings. Pres.d Revs. P. Teilhard & F. Pelletier, 1912.

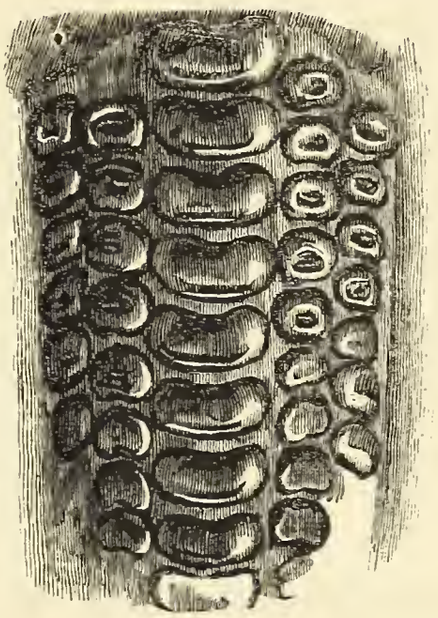
P.11901-02. Seven lateral teeth, two des.d & fig.d A.S.W. 1918, p. 69, pl. xv. figs. 18, 19; ibid. Pres.d Revs. P. Teilhard & F. Pelletier S.J., 1912.

P.9838. Tooth des.d & fig.d A.S.W. 1918, p. 68, pl. xv. fig. 15; Hastings. Rufford Coll.

principal series scarcely more than twice as broad as long, and about equalling in width the two flanking series, of which the teeth are much elongated transversely, some of the outer ones being even subdivided into two, and the inner ones much constricted; no row of small teeth within the principal series.

Form. & Loc. Gault: Kent.

Fig. 31.



Cœlodus gyrodoides; vomerine dentition, oral aspect, three-quarters natural size. [No. P. 3762.]

P. 609. Type specimen; Folkestone. *Egerton Coll.*

Cœlodus inæquidens, A. S. Woodward.

1893. *Cœlodus inæquidens*, A. S. Woodward, Geol. Mag. [3] vol. x. p. 491, pl. xvii. fig. 5.

Type. Left splenial, with dentition; British Museum.

A species of moderate size, known only by the splenial dentition. Teeth of principal series attaining a breadth somewhat more than twice as great as their length, and exceeding in width the two flanking series, of which the inner slightly exceed the outer teeth in size, all being about as broad as long; a row within the principal series represented by few minute round teeth; all the teeth smooth.

Form. & Loc. Cenomanian: Cambridge.

36157. Type specimen; Cambridge Greensand, Cambridge.
Purchased, 1861.

35383, 36158. Two fragmentary portions of splenial bone, probably of this species; Cambridge. *Purchased*, 1860, 1861.

Cœlodus cantabrigiensis, A. S. Woodward.

1895. *Cœlodus cantabrigiensis*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 208, pl. viii. fig. 2.

Type. Right splenial, with dentition; British Museum.

A large species, known only by the splenial dentition. Teeth on the splenial bone smooth; those of the principal series scarcely more than twice as broad as long, and nearly equal in width to the two flanking series; inner flanking teeth twice as broad as long, and twice as broad as the teeth of the outer series, which are scarcely broader than long; a row within the principal series represented by few small teeth.

Form. & Loc. Cenomanian: Cambridge.

P. 7236. The type specimen described and figured, *loc. cit.*; Cambridge Greensand. *Jesson Coll.*

Cœlodus fimbriatus, A. S. Woodward.

1893. *Cœlodus fimbriatus*, A. S. Woodward, Geol. Mag. [3] vol. x. p. 491, pl. xvii. fig. 6.

Type. Right splenial dentition; British Museum.

A large species, known only by the splenial dentition. Teeth of principal series on the splenial bone smooth or feebly crimped round the margin, somewhat less than three times as broad as long, about equalling in width the two outer series, which are nearly similar in size, irregular in form, slightly broader than long, and having a deep coronal pit with rugose or crimped margin.

Form. & Loc. Turonian: Kent.

43090. Type specimen; Lower Chalk, Halling, Kent. *Wetherell Coll.*

Cœlodus parallelus (Dixon).

1850. *Pycnodus parallelus*, F. Dixon, Geol. Sussex, p. 369, pl. xxxiii. fig. 3.

1888. *Cœlodus parallelus*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 308.

Type. Imperfect splenial dentition; Brighton Museum.

A large species known only by the splenial dentition. Teeth of

Coelodus ldevidens, A.S.W.

1918. Coelodus ldevidens, A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 69, pl. xv. figs. 19, 20.

Type. Right splenial; British Museum.
Form. & Loc. M. Purbeckian: Swanage.

P.10679. Type specimen, des.? & fig.? A.S.W. 1918, p. 69, pl. xv. fig. 19.
Pres.? by F. Hovenden, Esq., 1909.

33480. Left splenial, des.? & fig.? A.S.W. 1918, p. 69, pl. xv. fig. 20.

C. rostratus, labis, vetteri, multipinnatus ovalis spp. n. Gz Kramb. Gorj. 1895 Djela Jugoslav. Akad XVI pp. 24 – pls. figs. Cretac. "Austria" ok.

C. jacobi s.n. M. Eocene Assam India, M.G.K. Menon & K.N. Prasad 1958 Rec. G. Surv. India 85, 4: 565 pl. 22 (Splen. G. Surv. India).

1958. C. p. ex. feddeni nov. {Eocene Ranikot Gr.? W. Cea. India, K.N. Prasad & R. Rao, Rec. G. Surv. India 85, 4: 559 pl. 21 (splenial G.S.I.)

(?) 1929. C. parallelus R. Sarra, Rivista ital. Paleont. xxxv. p. 11: Cretac: Basilicata, Italy.

(?) 1896. Coelodus (Pycnodus) parallelus, F. Priem, Bull. Soc. Géol. France [3] vol. xxiv. p. 292, pl. ix. figs. 23-25. [Isolated teeth]

(?) 1902. Coelodus parallelus, M. Leriche, Ann. Soc. Géol. Nord, vol. xxxi. p. 131, pl. iv. fig. 3. [Jaw]

(?) 1912. Coelodus aff. parallelus, F. Priem, Bull. Soc. Géol. France [4] vol. xii. p. 266, pl. ix. fig. 7. [Vomer; Cretaceous, Murviel, Hérault.]

G. D'Erasmo, Catal. Pesci Foss. d. Tre Venezie (Mem. Ist. Geol. R. Univ. Padova, vol. vi.), p. 54, pl. vi. fig. 1.

Coelodus attenuatus, F. Priem, Bull. Soc. Géol. France [3] vol. xxvi (1898), p. 230, pl. ii. fig. 1; + Verona — Turonian; Dissé sous le Lude (Sarthe). [Left Splenial; Sorbonne.]

Coelodus sp., F. Priem, l.c. (1898), p. 232, pl. ii. f. 2. — L. Montian; Marne. [Britton.]

Coelodus anomalus, F. Priem, Comm. Serv. Géol. Portugal vol. 6. 1904. pp. 52, 53, fig. — U. Barremian; Lagosteiros, [Right Splenial; Geol. Surv. Portugal.]

Coelodus arcuatus, A. S. Woodward, Foss. Fishes Weald & Purb. Form. (Pal. Soc. 1916), 1918, p. 70, pl. xiii. fig. 5. — M. Purbeck; Swanage. [Vomer; Mus. Pract. Geol., Jermyn St.]

Coelodus bursauxi, F. Priem, Bull. Soc. Géol. France [4] vol. ix (1909), p. 325, fig. 11. — Upper Cenomian; Tunis. [Vomer.]

Coelodus [redacted] choffati, H. E. Sauvage, C. cuneiformis, C. delgadoi, C. borgesi, C. ribeiroi spp. U. Cret. Portugal C. de la bathiei.

Coelodus decaturensis, J. W. Gidley, Proc. U.S. Nat. Mus. vol. 46 (1913), p. 447, fig. 4. — L. Cretaceous; Decatur, Wise County, Texas. [Splenial; U.S. Nat. Mus.]

Coelodus fabadens, J. W. Gidley, loc. cit. p. 446, fig. 3. — Lower Cretaceous; Gainesville, Cooke Co., Texas. [Splenial; i.]

Coelodus glauconiensis, s.n. M. Leriche 1929, p. 264, tf. 19, — Santonian (Turonian): Belgium. [Imp. R. Splenial: N.H.M. Brussels].

Coelodus morgani, F. Priem, in J. de Morgan's Mission Sci. Perse, vol. iii (1904), p. 285, pl. x], fig. 1. — U. Chalk; Louristan, Persia. (Splenial) Also in de Morgan, Délégation en Perse — Ann. d'Hist. Nat. vol. i (1908) p. 3, pl. i. fig. 1.

Coelodus laurentii, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont. 1908), p. 70, pl. ii. f. 4. — L. Montian; Mont Aimé, Marne. [Vomer; Coll. Ponsort.]

principal series on the splenial bone smooth, somewhat more than three times as broad as long; those of the inner flanking series considerably more than half as broad as the latter.

Form. & Loc. Senonian: Sussex. etc.

Not represented in the Collection.

The following species have also been defined from fragmentary specimens and are not represented in the Collection :—

Cœlodus angustatus, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. (1856), p. 203. *Glossodus angustatus*, O. G. Costa, Atti Accad. Pontan. vol. vii. (1853), p. 27, pl. iii. figs. 12–15.—L. Cretaceous; Pietraroja, Naples. [Imperfect dentition.]

Cœlodus asperulus: *Pycnodus asperulus*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. xi. (1883), p. 24, pl. i. figs. 6, 7.—Neocomian; Haute Marne. [Splenial; Communal Museum, Doulevant-le-Château.]

Cœlodus browni, E. D. Cope, Journ. Acad. Nat. Sci. Philad. [2] vol. ix. (1894), p. 447, pl. xx. fig. 10.—Lower Cretaceous; Oklahoma. [Left splenial.] & Kansas.

S. W. Williston, Kansas Univ. Quarterly, vol. ix (1900), p. 28, pl. vi. fig. 12 (reprinted in Univ. Geol. Surv. Kansas, vol. vi. 1900, p. 254, pl. xxiv. fig. 12).

Cœlodus carentonensis: *Gyrodus carentonensis*, H. Coquand, Descript. Géol. etc. Départ. Charente, vol. ii. (1860), p. 97. *Cosmodus carentonensis*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 49, and Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 459, pl. xiv. fig. 1.—Cenomanian; Charente, France. [Portion of vomerine dentition, type of *Cosmodus*, Sauvage.]

Cœlodus discus, J. J. Heckel, *loc. cit.* vol. xi. (1856), p. 203. = Cœlodus *Pycnodus rhombus*, O. G. Costa (*errore*), *loc. cit.* vol. v. (1850), p. 332, pl. v. fig. 1.—Upper Jurassic; Torre d'Orlando, Naples.

Costai, Bassani & D'Erasmo, 1912.

Cœlodus fabarius: *Pycnodus fabarius*, E. Sismonda, Mem. R. Accad. Sci. Torino, [2] vol. xix. (1861), p. 457, pl. i. fig. 12.—Neocomian; Piedmont. [Splenial.]

Cœlodus major: *Cosmodus grandis*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 49, pl. iii. fig. 29.—Cenomanian; Seignelay, Yonne, France. [Splenial.]

Cœlodus mesorachis, J. J. Heckel, *loc. cit.* vol. xi. (1856), p. 220, pl. viii. fig. 1; F. Bassani, *ibid.* vol. xlv. (1882), p. 202.—Upper Cretaceous; Island of Lesina, Dalmatia. [Imperfect trunk; Court Museum, Vienna.]

Cœlodus muralti, J. J. Heckel, Bericht. Mittheil. Freund. Naturw. Wien, vol. iv. (1848), p. 184, woodc., and *loc. cit.* vol. xi.

(1856), p. 225, pl. viii. fig. 2. *Picnodus muraltii*, A. von Morlot, Haidinger's Naturw. Abhandl. vol. ii. (1848), p. 275, woodc.—Cretaceous; near Pola, Istria. [Splenial dentition.]

Cœlodus oblongus, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. (1856), p. 222, pl. ix. figs. 1–3; F. Bassani, *ibid.* vol. xlv. (1882), p. 202.—Upper Cretaceous; Island of Lesina. [Upper portion of head and trunk; Heckel Collection.]

Coel. costai, Bassani & D'Erasmo, 1912.

=*Cœlodus pyrrhurus*, J. J. Heckel, *loc. cit.* vol. xi. (1856), p. 223, pl. ix. figs. 4–6.—Cretaceous; Island of Meleda, Dalmatia. [Portion of caudal region; Imperial Geological Survey Museum, Vienna.]

Cœlodus subsimilis: *Pycnodus subsimilis*, J. Cornuel, Bull. Soc. Géol. France, [3] vol. viii. (1880), p. 156, pl. iii. figs. 16, 17.—Portlandian; Dépt. Meuse, France. [Vomerine and splenial dentition; Daval Collection.]

An undescribed species of *Cœlodus* is represented by portions both of the upper and lower dentition from the Cretaceous near Beyrout, now in the Museum of the Syrian Protestant College, Beyrout.

Imperfect skeletons of an undetermined species probably of *Cœlodus*, from the Cretaceous of the neighbourhood of Naples, are described under the name of *Anomiophthalmus vetustus* by O. G. Costa, Ittiol. Foss. Ital. (1856), p. 30, pl. iii. figs. 4, 5, and Atti Accad. Pontan. vol. viii. (1864), p. 116, pl. xi. figs. 4, 5. Here may also probably be placed the imperfectly known *Pycnodus rotundatus* (O. G. Costa, *ibid.* 1864, p. 82), as suggested by F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. (1882), p. 233.

The so-called *Glossodus heckeli*, O. G. Costa (Atti Accad. Pontan. vol. viii. 1864, p. 109, pl. ix. figs. 12, 13), from the Cretaceous of Pietraroja, is too imperfect for determination (F. Bassani, *loc. cit.* 1882, p. 233).

Genus **ANOMŒODUS**, Forir.

[Ann. Soc. Géol. Belgique, vol. xiv. 1887, Mémoires, p. 25.]

An imperfectly known genus. Head-bones ornamented with reticulating rugæ; the smaller teeth usually with an apical indent, the principal teeth quite smooth or with a very feeble linear indent. Oral surface of vomer nearly flat, with teeth of irregular sizes in from three to five longitudinal series; splenial dentition restricted

Coelodus latus, M. Leriche, Ann. Soc. Géol. Nord, vol. xxx (1901), p. 154, pl. v. fig. 1. — L. Montian; Paris Basin (Mont Aimé). [Splenial dentition.]
Coelodus sp. J. Cottreau, Ann. de Pal. xi (1922) p. 182 pl. xvii f. 12. Senonian; E. Coast Madagascar.

Coelodus prieni, M. Leriche, Rev. crit. Paléozool. vol. vii (1903), p. 129. Coelodus latus, M. Leriche (non Kramberger), Ann. Soc. Géol. Nord, vol. xxx (1901), p. 154, pl. v. fig. 1. — Montian; Mont Aimé, Marne, France.

Coelodus syriacus, L. Hussakof, Bull. Amer. Mus. N. H., vol. xxxv (1916), p. 135; text-fig. 1. — Upper Cretaceous; near Beyrout, Syria. [Right splenial.]
Coelodus riberoi, H. E. Sauvage,

C. streckeri s.n., C.W. Hibbard 1940. Univ. Kansas Sci. Bull. 26 p. 373 pl. xli. U. Cret. Kansas. Brewster Kansas Univ.
Coelodus suprajurensis, H. E. Sauvage, Bull. Soc. Géol. France [4] vol. i (1901), p. 550, pl. xii. fig. 13 (? also fig. 14). — Portlandian-Purbeckian; Wimille, Boulogne. [Vomer; Mus. Boulogne.]

Coelodus stantoni, S.W. Williston, Kansas Univ. Quarterly, vol. ix (1900), p. 28, pl. vi. fig. 12, pl. viii. fig. 6 (reprinted in Univ. Geol. Surv. Kansas, vol. vi. 1900, p. 255; pl. xxiv. fig. 12, pl. xxvi. fig. 6). — Cretaceous (Kiowa Shale); Kansas. [Portion of splenial.]

Coelodus materanus sp.n. A. Silvestri, Atti Pont. Acc. Romana Nuovi Lincei, v. lxxvi (1923) p. 232 4 figs. (non vidi)
? G. D'Erasmo, Riv. Ital. di Pal. v. xxx (1924) p. 13.

A. sp. Cenoman. Bahanje. Weber 1935b, p. 31., pl. i. f. 1–3, 30. (with ?). Stromer, 1936, p. 78. ff. 16 A.

1953. A. cf. S. R. Bell and Carleis Bat. N.S. 8 p. 20 ff. 4

1896. Anomoeodus (Pycnodus) subclavatus, F. Priem. Bull. Soc. Géol. France [3] vol. xxiv. p. 293, pl. ix. fig. 26.

1898. Anomoeodus subclavatus, F. Priem, Bull. Soc. Géol. France [3] vol. xxvi. p. 233, pl. ii. fig. 4 (? fig. 3).

1906. Anomoeodus subclavatus, M. Leriche, Mém. Soc. Géol. Nord, vol. v. p. 136.

1911. Anomoeodus subclavatus, F. Priem, Ann. Paléont. vol. vi. p. 19, pl. iii. fig. 22. [Splenial; U. Senonian, Aisne.]

to a space considerably separated throughout its extent from the thin oral border of the bone, comprising one principal series of teeth, flanked within by at least one small series and outside by two or more small series. Scales ornamented with reticulating rugæ.

This amended definition is given on the assumption that the so-called *Gyrodus angustus*, Agassiz, belongs to the same genus as *Pycnodus subclavatus*, Agassiz. The splenial bone in the first-named species differs from that of all other known Pycnodonts in its wide, toothless margin; but neither in the so-called *Pycnodus subclavatus* nor in any of the associated species has the imperfect nature of the specimens yet permitted the observation of this feature. Future discoveries must determine whether or not the arrangement here adopted is justifiable.

The splenial dentition of *Anomœodus* is arranged as in *Mesodon*, but the form of the splenial bone itself is quite different from that of the last-named genus, being similar to that of *Pycnodus*.

Anomœodus subclavatus (Agassiz).

1799. Figures by Faujas St. Fond, Hist. Nat. Mont. St. Pierre, Maestricht, pl. xviii. fig. 8, pl. xix. fig. 4.

1833–44. *Pycnodus subclavatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17, pt. ii. p. 198, pl. lxxii. *a*. fig. 59.

1848–52. *Pycnodus*, P. Gervais, Zool. et Pal. Franç. pl. lxix. fig. 23.

1872. *Pycnodus cretaceus*, H. E. Sauvage (*errore*), Bibl. École Hautes Études, vol. v. art. 9, p. 13, pl. i. figs. 3–6.

1887. *Cœlodus subclavatus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 249.

1887. *Anomœodus subclavatus*, H. Forir, Ann. Soc. Géol. Belgique, vol. xiv. Mém. p. 25, pl. i. fig. 1.

Type. Principal splenial teeth; Paris Museum of Natural History.

The type species, known only by the splenial dentition. Teeth of the principal series on the splenial bone slightly arcuated, tapering and turned forwards at the inner extremity, attaining a breadth more than three times as great as their length; those of the single inner series very small and rounded, irregularly arranged; flanking teeth in four irregular series, these mostly smooth and together not equalling in width the principal series, the innermost teeth slightly broader than long, the next nearly similar, and the two outermost series insignificant.

A good figure of this form of dentition is published by Forir, *loc. cit.*, but there seems to be much variation even in the specimens

from a single locality (Maastricht). The teeth of the two innermost flanking series are frequently crowded and almost triangular in form, and more nearly equal in size than shown in the figure quoted.

Form. & Loc. Upper Cretaceous (Danian and Senonian): Holland, Belgium, and France [1].

42991–93. Portion of right splenial dentition and fragments; Danian, Maastricht, Holland. *Van Breda Coll.*

28717, 30752. Detached teeth, probably of this species; Upper Senonian, Ciply, near Mons, Belgium. *Purchased*, 1853.

Anomœodus distans (Coquand).

1860. *Pycnodus distans*, H. Coquand, Descript. Géol. etc., Départ. Charente, vol. ii. p. 97.

1880. *Pycnodus distans* = *Pycnodus cretaceus*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. viii. p. 460, pl. xiv. fig. 4.

Type. Imperfect splenial dentition.

A species of moderate size, known only by part of the splenial dentition. Teeth of the principal series on the splenial bone much arcuated and tapering in the inner half, about three times as broad as long; teeth of the innermost row of the flanking series round and deeply pitted, smaller than those of the next adjoining row, which are almost or quite smooth.

Form. & Loc. Senonian: Charente, France.

Not represented in the Collection.

Anomœodus angustus (Agassiz).

1837–44. *Gyrodus angustus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 235, 246, pl. lxvi. *a*. figs. 14, 15.

(?) 1839–44. *Pycnodus cretaceus*, L. Agassiz, *ibid.* p. 198, pl. lxxii. *a*. fig. 60. [Splenial teeth; Manchester Museum.]

1833–44. *Pycnodus angustus*, L. Agassiz, *ibid.* pt. i. p. 17, pt. ii. p. 199 (name only).

1844. *Pycnodus elongatus*, L. Agassiz, *ibid.* p. 199.

1845. *Gyrodus angustus*, A. E. Reuss, Verstein. böhm. Kreideform. pt. i. p. 9, pl. iv. fig. 55.

1845. *Pycnodus rhomboidalis*, A. E. Reuss, *ibid.* pt. i. p. 10, pl. iv. figs. 46–54. [Detached teeth.]

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[1] Fragments of dentition from the Upper Senonian and Danian of Scandinavia are also ascribed to this species by J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iv. (1890), p. 416, pl. xlii. figs. 16–18.

1909. Anomoeodus angustus, A.S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 163, pl. XXXIV. figs. 3, 4.

?1915. Anomoeodus angustus, F. Priem, Bull. Soc. Géol. France [4] vol. xiv. p. 369, pl. x. figs. 1-7. [Teeth; Egypt.]

1911. Anomoeodus angustus, F. Priem, Ann. Paléont. vol. vi. p. 18, pl. iii, figs. 19, 20. [Splenials; L. Senonian, Saint-Paterne, Indre-et-Loire.]

(?)1912. Anomoeodus angustus, F. Priem, Bull. Soc. Géol. France [4] vol. xii. p. 270, pl. ix. fig. 9. [L. Senon.; Périgueux.]

1930. Anomoeodus angustus, W. Weiler, p. 26, pl. xii. f. 27-33. Phosph. Egypt.

25780. Des. & figd. A.S.W. 1909, p. 163, pl. XXXIV. fig. 3.

1845. *Pycnodus subdeltoideus*, A. E. Reuss, *ibid.* pt. i. p. 10, pl. iv. figs. 38–42. [Detached teeth.]
1850. *Gyrodus angustus*, F. Dixon, Geol. Sussex, p. 370, pl. xxx. fig. 14, pl. xxxiii. fig. 1.
1855. *Pycnodus cretaceus*, E. Hébert, Mém. Soc. Géol. France, [2] vol. v. p. 353, pl. xxvii. fig. 7.
1856. *Pycnodus rhomboidalis*, C. E. Fischer, Allg. deutsche Nat. Zeit., n. s., vol. ii. p. 137, figs. 2, 3.
1875. *Pycnodus cretaceus*, H. B. Geinitz, Palæontogr. vol. xx. pt. i. p. 300, pl. lxv. figs. 12–14, and pt. ii. p. 217, pl. xl. figs. 30–32.
1878. *Pycnodus cretaceus*, A. Fritsch, Rept. u. Fische böhm. Kreideform. p. 22, pl. ii. figs. 1–4, woodc. 48.
1878. *Gyrodus angustus*, A. Fritsch, *ibid.* p. 25, woodc. 53.
1887. *Cœlodus angustus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 249.
(?) 1887. *Cœlodus cretaceus*, K. A. von Zittel, *ibid.* p. 249.
1888. *Cœlodus angustus*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 307.
(?) 1888. *Cœlodus cretaceus*, A. S. Woodward, *ibid.* p. 308.

Type. Series of teeth; British Museum (in part).

A small species, known by the dentition and part of the head and trunk. Teeth of the principal series on the splenial bone very obliquely set, truncated at their outer extremity, rapidly tapering to a blunt point at the inner extremity, and when young and unworn marked with a slight transverse coronal furrow; inner teeth in two irregular series, those of the first elongated, those of the innermost much smaller and round, both deeply pitted; teeth of the flanking series in about three or four very irregular rows, all deeply pitted, the innermost transversely elongated and much larger than any of the others, which are rounded. Scales marked with coarse reticulations, and serrations of the ventral ridge-scales conspicuous, long, and slender.

The fragment of dentition named *Pycnodus cretaceus* seems to differ only from the typical corresponding teeth of this species in its relatively large size. There are intermediate specimens in the Collection.

Form. & Loc. Senonian: S.E. England, and Meudon, France. Cenomanian: Saxony and Bohemia [1].

25731, 25780. Portion of axial skeleton of trunk, with another portion of fish displaying scales and the two splenial

[1] Specimens are also recorded from Switzerland by W. A. Ooster, Protozoe Helvetica, 1870, vol. ii. p. 45. A right splenial from the Danian of Maastricht, apparently not of this species, is named *Anomœodus cretaceus* (Ag.) by H. Forir, Ann. Soc. Géol. Belgique, vol. xvi. (1889), Mém. p. 450, pl. xiv. fig. 2.
= Anomoeodus forii, s.n. M. Leriche, 1929, p. 268.

bones, noticed and figured by Dixon, *op. cit.* p. 370, pl. xxxiii. fig. 1; Chalk, Houghton, Sussex. In his brief notes Dixon erroneously refers to the ventral border of the fish as "the nape of the neck;" and the vacuities shown in the splenial bone may certainly be regarded as accidental. They are not observable in the right splenial, and if the drawing be not "restored" the last-named bone must have been broken since it left the artist. There is, however, apparently much "restoration" in the figure of the left splenial, and it is thus probable that no accident has happened since the specimen was originally studied.

Dixon Coll.

P. 5733. Plaster cast of portion of fish figured by Fritsch, *loc. cit.* figs. 1, 2, woodc. 48; Plänerkalk, near Schlan, Bohemia.

Presented by Dr. Anton Fritsch, 1888.

P. 1616. Series of five principal teeth of splenial bone, being one of the type specimens described and figured by Agassiz, *tom. cit.* p. 235, pl. lxvi. *a.* fig. 15; Sussex.

Egerton Coll.

P. 5408. Portion of left splenial bone and dentition, showing the broad toothless margin; Lewes, Sussex.

Presented by P. E. Coombe, Esq., 1888.

39049. Fine portion of large left splenial dentition, figured by Dixon, *op. cit.* pl. xxx. fig. 14; Houghton.

Bowerbank Coll.

P. 7458. Fragment of similar dentition, probably the specimen named *Pycnodus angustus*, Agassiz, *tom. cit.* p. 199; Kent.

History unknown.

49097. Portion of small left splenial; English Chalk.

Mrs. Smith's Coll.

49805. Portion of small left splenial, showing principal and two series of outer teeth; Newtimber, Sussex. *Capron Coll.*

P. 3784. Imperfect small right and left splenial dentition; Sussex.

Enniskillen Coll.

39081. Portion of principal and two outer series of splenial teeth; English Chalk. *Bowerbank Coll.*

P. 3784 a. Fragment probably of vomer of this species; Sussex.

Enniskillen Coll.

1909. *Aromoeodus willetti*, A. S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 164, pl. XXXIV. fig. 5.

Anomœodus willetti, A. S. Woodward.

1893. *Anomœodus willetti,* A. S. Woodward, Geol. Mag. [3] vol. x. p. 489, pl. xvii. fig. 1.

Type. Imperfect skull, with dentition; Brighton Museum.

A small species, with teeth very irregularly arranged. Teeth of the principal series on the splenial bone obliquely set, very irregular in size and shape, wide mesially, tapering at each extremity, and not much broader than long; inner teeth relatively large, in one series, usually broader than long, with axis oblique; outer teeth in about three very irregular series, mostly smaller than the teeth of the inner series. Vomerine dentition anteriorly in three series, posteriorly in five, but extremely irregular; the largest teeth much antero-posteriorly elongated and comprised in the outermost series. Nearly all the teeth indented, the smaller ones having the pit especially conspicuous and surrounded with a crenulated margin.

Form. & Loc. Turonian: Sussex.

Not represented in the Collection. The type and only known specimen, from the Lower Chalk of Glynde, is preserved in the Willett Collection, Brighton Museum, and is important as exhibiting some features in the cranial osteology of the fish. The vomer is single; the mandibular suspensorium is strongly inclined forwards; the pterygo-palatine arcade is delicate, toothless, and fused throughout the greater part of its length with the base of the skull; the parasphenoid has a deep inferior lamellar keel; the articulation of the mandible is very deep and narrow; and there is a large superficial bone apparently to be identified with the preoperculum.

Anomœodus fraiponti, Forir.

1889. *Anomœodus fraiponti,* H. Forir, Ann. Soc. Géol. Belgique, vol. xvi. Mém. p. 445, pl. xiv. fig. 1.

Type. Splenial dentition; Ubaghs Collection, Maastricht.

A species somewhat smaller than the type, known only by the splenial dentition. Teeth of the principal series on the splenial bone scarcely arcuated, blunt at each extremity, attaining a breadth more than three times as great as their length, and usually subdivided into small teeth in the anterior part of the bone; inner teeth very small, in two irregular series; outer teeth equally small, in three or four irregular series.

Form. & Loc. Upper Cretaceous (Danian): Holland.

42994. Part of principal series of splenial teeth of right side; Maastricht. *Van Breda Coll.*

Anomœodus muensteri (Agassiz).

1833–44. *Pycnodus depressus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17, pt. ii. p. 199 (name only).

1839–44. *Pycnodus munsteri*, L. Agassiz, *ibid.* vol. ii. pt. ii. p. 197, pl. lxxii. *a.* figs. 26–39.

1839–44. *Pycnodus complanatus*, L. Agassiz, *ibid.* p. 197, pl. lxxii. *a.* figs. 40–48. [Detached teeth; Royal Bohemian Museum, Prague.][1]

(?) 1879. *Pycnodus munsteri*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. p. 42, pl. ii. fig. 4 (*non* pl. i. fig. 4).

1887. *Cœlodus münsteri*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 249, fig. 262.

Type. Detached teeth; Palæontological Museum, Munich.

A species of moderate size, known only by the dentition. Teeth of the principal series on the splenial bone slightly arcuated, tapering and sharply turned forwards at the inner extremity, attaining a breadth about three times as great as their length; [inner teeth unknown]; teeth of the two flanking series very irregular, relatively small, not pitted, and mostly broader than long [perhaps succeeded without by other series]. Vomerine dentition very narrow, convex from side to side, with teeth closely arranged and not pitted: median teeth ovoid, the hindermost twice as broad as long; teeth of the inner lateral series broader than long, almost pear-shaped, and their long axis oblique; outermost teeth insignificant and irregularly rounded.

Form. & Loc. Cenomanian: Bavaria.[2] (?) Upper Neocomian: Yonne, France.

[1] Indeterminable fragments are also described under this name by A. E. Reuss, Verstein. böhm. Kreideform. pt. i. (1845), p. 9, pl. iv. figs. 27–36 (Bohemian Plänerkalk); Pictet & Renevier, Foss. Terrain Aptien Perte du Rhone (1854), p. 10, pl. i. fig. 4 (Switzerland); Pictet & Campiche, Foss. Terrain Crétacé St. Croix (1858), p. 65, pl. viii. figs. 24, 25 (Switzerland); H. E. Sauvage, Bibl. École Hautes Études, vol. v. art. 9 (1872), p. 8, figs. 11, 12 (La Sarthe); and H. B. Geinitz, Palæontogr. vol. xx. pt. i. (1875), p. 301, pl. lxv. figs. 15–21 (Saxon Plänerkalk), pt. ii. p. 217, pl. xl. fig. 33. The imperfect splenial dentition of a species of *Cœlodus* from the Plänerkalk of Bohemia is also named *Pycnodus complanatus* by A. Fritsch, Rept. u. Fische böhm. Kreideform. 1878, p. 21, pl. ii. fig. 5, woodc. 47. Another splenial, perhaps of *Anomœodus*, is similarly recorded from the Upper Neocomian of Monéteau, Yonne, France, by H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 41, pl. i. fig. 5.

[2] The fragments from the Neocomian and Aptian of Switzerland ascribed to this species by Pictet and others (Pictet & Renevier, Foss. Terrain Aptien Perte du Rhone, 1854, p. 9, pl. i. figs. 2, 3; Pictet & Campiche, Foss. Terrain Crétacé St. Croix, 1858, p. 61, pl. viii. figs. 21–23) are incorrectly determined.

1888. An. of. compsolamedus. H.T. Sauvage. Vert. Foss Port. 19 pl. i fig. 10

1908. Anomoeodus muensteri, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont.), p. 40, pl. ii. fig. 1. [Splenial from Aptian, Yonne.]

1910. Microdon muensteri, M. Leriche, Bull. Soc. Géol. France [4] vol. x. p. 465, pl vi. fig. 6. [Splenial; U. Necom., Sermaize, Marne.]

1929. Anomoeodus munsteri, M-Leriche, p. 266.

1946. Microdon muensteri L. Hussakof, p. 41 fig. 6.

A. woodwardi s.a. U. Cret. Portugal M.S. Sauvage
1898 Rev. Fos Portugal. 18 pl. 1 f. 20.

Anomoeodus barberi s.n. L. Hussakof 1947, Fieldiana Geology 10 m. p. 23 fig. 9. U. Cret. Arkansas: R. Mans. Austin Chicago N.H.M.

Anomoeodus sp. U. Cret. Ripley Fm.: Coon Creek, Tennessee, B. Wade, 1926.

Anomoeodus cottreaui, J. Priem, Bull. Soc. Géol. France [4] vol. xii (1912), p. 266, pl. ix. fig. 8. — Turonian; Barry, Rhône. [Left splenial.]

Anomoeodus latidens, J. W. Gidley, Proc. U. S. Nat. Mus. vol. 46 (1913), p. 448, fig. 5. — Cretaceous (?); Tupelo, Mississippi. [Splenial; U.S. Nat. Mus.] A. L. marylandicus, v.n. C.T. Berry 1939, Amer. Mid. Nat. 22 m. 1746, 1 f. Cret. Md.

Anomoeodus mississippiensis, J. W. Gidley, Proc. U. S. Nat. Mus. vol. 46 (1913), p. 449, fig. 6. — Cretaceous (?); Guntown, Mississippi. [Splenial; U.S. Nat. Mus.]

faba, Leidy = Pycnodus phaseolus, O. P. Hay, Amer. Nat. vol. xxxiii (1899), p. 788; H. W. Fowler, Bull. Geol. Surv. New Jersey, no. 4 (1911), p. 146, fig. 90.

P. 270. Portion of right splenial dentition; Greensand, Regensburg. *Purchased*, 1880.

P. 1656; P. 3753. Detached principal splenial teeth; Greensand, Kelheim. *Egerton & Enniskillen Colls.*

Anomœodus superbus, A. S. Woodward.

1893. *Anomœodus superbus*, A. S. Woodward, Geol. Mag. [3] vol. x. p. 489, pl. xvi. fig. 5.

Type. Left splenial dentition; Woodwardian Museum, Cambridge.

A large species, known only by the splenial dentition. Teeth of the principal series on the splenial bone slightly arcuated, somewhat tapering and turned forwards at the inner extremity, attaining a breadth more than three times as great as their length; inner teeth in two series, those of the one adjoining the principal teeth large and irregular in form, usually with long axis oblique, and those of the innermost row small and rounded; flanking teeth in three series, smooth, diminishing outwards and all smaller than the large series of inner teeth.

Form. & Loc. Cenomanian (Cambridge Greensand): Cambridgeshire.

41799. Portion of principal series and one inner tooth of right splenial; Cambridge Greensand, Cambridge. *Purchased*, 1869.

35384. Portion of small right splenial dentition; Cambridge. *Purchased*, 1860.

36159. Imperfect right splenial, with principal teeth; Cambridge. *Purchased*, 1861.

P. 7237. Four portions of splenial; Cambridge. *Jesson Coll.*

The portions of dentition described under the following names may also perhaps pertain to *Anomœodus* :—

Pycnodus aulercus, H. E. Sauvage, Bibl. École Hautes Études, vol. v. art. 9 (1872), p. 12, figs. 1, 2.—Turonian; Requeuil, Sarthe, France. [Portion of splenial dentition.]

Pycnodus cenomanicus, H. E. Sauvage, *ibid.* p. 11, figs. 7–9.—Cenomanian; Mans, Sarthe, France. [Imperfect left splenial.]

Pycnodus faba, J. Leidy (*non* H. von Meyer), Proc. Acad. Nat. Sci. Philad. 1872, p. 163, and Contrib. Extinct Vert. Fauna W. Territ. (Rep. U.S. Geol. Surv. Territ. vol. i.

1873), p. 292, pl. xix. figs. 15, 16.—Cretaceous; Mississippi and New Jersey. [Fragments of splenial.]

Pycnodus ricordeaui, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 40, pl. ii. fig. 3.—Upper Cretaceous (Aptian); Gurgy, Yonne. [Left splenial.]

Pycnodus robustus, J. Leidy, Proc. Acad. Nat. Sci. Philad. 1857, p. 168, and *op. cit.* 1873, p. 293, pl. xxxvii. figs. 18, 19.—Cretaceous; New Jersey. [Detached tooth.]

Pycnodus varians, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 610, pl. xi. fig. 7.—Neocomian; Wassy, Haute Marne, France. [Right splenial.]

Genus **COCCODUS**, Pictet.

[Descript. Poiss. Foss. Mont Liban, 1850, p. 51.]

Trunk comparatively elongated and head relatively very large. Head and opercular bones ornamented with tubercles and fine ridges, and a large, ascending, laterally compressed, bilaterally symmetrical spine fixed upon the occipital region of the cranium; teeth smooth, but indented and partly mammillated, those of the vomer in at least three, and those of the splenial apparently in three regular series. Neural and hæmal arches of axial skeleton of trunk robust, but not expanding sufficiently to encircle the notochord. Fin-rays stout and well-spaced, articulated and branching distally. Pectoral arch much expanded at its inferior extremity, ornamented with fine ridges and tuberculations, produced behind into two large spines, and forwards into another. [Paired fins unknown;] dorsal and anal fins not much extended, opposed; caudal fin small and fan-shaped, having a convex posterior border. Squamation absent.

Coccodus armatus, Pictet.

[Plate XVI. fig. 4.]

1850. *Coccodus armatus*, F. J. Pictet, Descript. Poiss. Foss. Mont Liban, p. 51, pl. ix. fig. 9.

1887. *Coccodus armatus*, J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. p. 546, pl. xxx. fig. 1.

Type. Vertically crushed head and anterior abdominal region; Geneva Museum.

The type species, attaining a length of about 0·18. Head with opercular apparatus occupying about one-third of the total length of the fish. Occipital spine acuminate, its length considerably exceeding twice its maximum breadth, and about equalling two-

Pycnodus coniacensis, H. Coquand,

Pycnodus occidentalis, H. Coquand,

[H. W. Fowler, Bull. Geol. Surv. New Jersey, no. 4 (1911), p. 147, fig. 91.

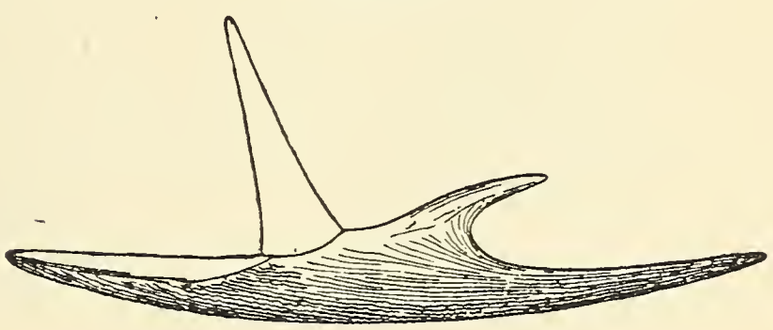
1898. *Coccodus armatus*, A. S. Woodward, Ann. Mag. Nat. Hist. [7] vol. ii, p. 486.

thirds of the depth of the head at its insertion; its sides marked with fine, regular longitudinal ridges, and the anterior and posterior margins delicately serrated. Vomerine teeth triangular in form, mammillated, and closely arranged, the median series considerably larger than the flanking series and alternating with the latter; splenial dentition imperfectly known, but the teeth with hollowed crown and blunt lateral extremities.

Form. & Loc. Upper Senonian: Mt. Lebanon, Syria.

P. 4742. Imperfect laterally compressed specimen, described and figured by Davis, *loc. cit.*; Hakel. The original description is not altogether accurate, and requires some supplementing and correction. The vomer is crushed so that part of its dentition is exposed, displaying the three series of teeth as described in the above diagnosis; and the two principal series of the right splenial are also shown from the oral aspect. So far as can be ascertained, the inferior expanded extremity of the left half of the

Fig. 32.



Coccodus armatus; left clavicle, outer aspect. [No. P. 4742.]

pectoral arch has the form indicated in the accompanying diagrammatic sketch (fig. 32), there being one anterior, and two posteriorly directed spines. The right half of the arch in this specimen has been displaced and overturned, and the angle between the two posterior spines increased by fracture. The facial and opercular bones, and some elements behind the occiput, are too much crushed for precise recognition; and little can be said of the axial skeleton of the trunk beyond noting that it exhibits the ordinary Pycnodont characters. There are short ribs in the abdominal region. The remains of the anal fin opposed to the dorsal are very fragmentary, and only part of the lower lobe of the caudal fin is preserved.

Lewis Coll.

P. 4003, P. 4742 a. Head and part of abdominal region, vertically crushed, and cleft along the plane of the dentition; Hakel. The tuberculated roof of the skull is shown, with its great, laterally compressed, solid occipital spine; and behind the occiput are portions of a pair of large unornamented plates too imperfect for determination. No sutures can be observed in the cranial roof, and the ethmoidal extension is very narrow. The dentition agrees with that of the preceding specimen; and the pectoral arch again shows the three spines, with some fragments apparently of fin-rays. The short ribs are also well-preserved. *Lewis Coll.*

39227. Imperfect cranium, with complete occipital spine, in side view, shown of the natural size in Pl. XVI. fig. 4; Hakel. The base of the skull is bent sharply downwards at the anterior extremity of the otic region; and the median ethmoidal plate is shown in advance of the orbit. *Tristram Coll.*

P. 3767. Vomerine dentition doubtfully ascribed to this species; Hakel. The dentigerous surface is convex from side to side, and the teeth are closely arranged in five series. They are irregular in form, not rounded; and only a few of those placed anteriorly exhibit feeble traces of an apical pit. *Enniskillen Coll.*

Coccodus lindstroemi, Davis.

1890. *Coccodus lindstrœmi*, J. W. Davis, Quart. Journ. Geol. Soc. vol. xlvi. p. 565, pl. xxii.

Type. Nearly complete fish; State Museum, Stockholm.

A smaller species than the type, distinguished by the relatively larger size of the head and the coarse denticulations on the hinder border of the occipital spine.

In the type specimen the occipital spine is evidently crushed backwards, and the description of the remains of the opercular apparatus by Davis is based on too fragmentary evidence to be accepted as correct.

Form. & Loc. Upper Senonian: Hakel, Mt. Lebanon, Syria.

Not represented in the Collection.

As pointed out by J. W. Davis (Trans. Roy. Dublin Soc. [2] vol. iii. 1887, p. 548), the splenial dentition from Hakel described under the name of *Gyrodus syriacus* by O. Fraas (Aus dem Orient,

1903. Coccodus lindahroemi, O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix. p. 409, pl. xxix. fig. 1.

Coccodus insignis, O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix (1903), p. 410, pl. xxix. figs. 2–5. – U. Cretaceous; Hajula, Lebanon. [Imperfect fish; Amer. Mus. N. H.] A. S. W. 1942, J. M. N. H. (c) 9 p. 555.

Xenopholoides H. W. Fowler 1958, Not. Nat. 310:7

1878, pt. ii. p. 92, pl. iv. figs. 5, 6), probably belongs to *Coccodus*. The specimen best displaying the teeth, now in the Stuttgart Museum, may even belong to the typical *C. armatus*, but the teeth of its inner flanking series are relatively broader than those in the British Museum fossil, no. P. 4742.

Genus **XENOPHOLIS,** Davis.

[Trans. Roy. Dublin Soc. [2] vol. iii. 1887, p. 548.]

Trunk comparatively elongated and head large. Head and opercular bones ornamented with tubercles and fine ridges, and a large, ascending, laterally compressed, bilaterally symmetrical spine fixed upon the occipital region of the cranium; teeth smooth, rounded within the mouth, pointed and prehensile in front. Neural and hæmal arches of axial skeleton of trunk robust, but not expanding sufficiently to encircle the notochord. Pelvic fins relatively large; dorsal fin occupying at least the hinder half of the back, and the anal somewhat less extended, arising more posteriorly. Abdominal region, and middle portion of caudal region, covered with large imbricating rhombic scutes, each with one diagonal raised into a keel and terminating in a point behind.

The present writer is acquainted only with two specimens referable to this genus—the type described below, and the other in the Court Museum, Vienna. The latter is best preserved, exhibiting the occipital spine and part of the dentition.

Xenopholis carinatus, Davis.

1887. *Xenopholis carinatus,* J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. p. 549, pl. xxix. fig. 4.

Type. Imperfect fish; British Museum.

The type species, attaining a length of about 0·18, as yet imperfectly definable. Dorsal fin with not less than nineteen, anal fin with about sixteen rays. Scales relatively large, the dorso-ventral series above the origin of the anal fin comprising only eight or nine; those of the caudal region apparently confined to its middle, but continued quite to the base of the caudal fin-rays. Each scale with a small transverse keel terminating in a median or inferior acumination at its hinder margin, and the ornament consisting of more or less nodose parallel ridges diverging antero-superiorly and antero-inferiorly from this keel; ornament of the external bones similarly consisting of nodose ridges or series of acuminate tubercles. The ridge-scale at the origin of the anal fin produced

into two short median spines, both smooth and the first half as long as the second.

Form. & Loc. Upper Senonian: Mount Lebanon, Syria.

39239. The type specimen described and figured by Davis, *loc. cit.*; probably from Hakel. Part of the anterior half of the fish is wanting, and the remainder is so much crushed and distorted that no elements are distinctly recognizable. Two bodies in the abdominal region might be interpreted as ring-vertebræ, but they are probably only the expanded hæmal arches; and there are no traces of ossifications in the notochordal sheath in the caudal region. Owing to the partial absence of the squamation in the latter region, the neural and hæmal spines are exposed; they seem to bear the characteristic laminar expansion on their anterior border. The pelvic fins are well-developed and comprise considerably elongated stout rays, which do not appear to bifurcate, but are articulated at moderately wide intervals in their distal two-thirds. The dorsal and anal fins consist of similar rays, and the two laterally-apposed halves of each are so readily separable, that they are mostly displaced in the fossil and produce the false impression of more fin-rays than supports. Most of these supports are widened with little "wings." Of the caudal fin only part of the lower lobe is preserved; it exhibits three or four slender fulcral rays at its origin. Some of the scales of the right side are displayed from the outer aspect, and there are also good impressions of the external face of those of the left side. Their form and ornamentation are noted in the diagnosis, and it is unfortunate that the nature of their attached face cannot be determined. The very large ridge-scute shortly in advance of the pelvic fins has already been remarked upon by Davis; and there can be no doubt that the two smooth spines at the origin of the anal fin are fixed either on one or two of the scutes of the ventral ridge-series.

Tristram Coll.

Genus **PALÆOBALISTUM,** Blainville.

[Nouv. Dict. d'Hist. Nat. vol. xxvii, 1818, p. 338.]

Trunk discoidal, not produced at the caudal pedicle. Head and opercular bones externally granulated or rugose; teeth smooth, sometimes feebly indented; vomerine teeth arranged in five regular

39239 exhibits several of the pharyngeal teeth (*Ancistrodus*), as noticed by A.S.W. Geol Mag. [6] vol. iv (1917), p. 387.

P.10700. Crushed specimen, distorted in front
Pharyngeal teeth noticed by A.S.W. Geol. Mag. [6]
vol. iv (1917), p. 387.

P. sp. Cat. Coll. Trieste G. D'Ancona 1952,
Att. Mus. Civ. Stor. Nat. Trieste N 4, p. 96 N. 6 plät. 1.

Medal type specimen pr. A. Y. Olot 1903 - P6126 .
(Cat. 0533)

P. 9830. Specimen in counterpart, descr. & figd.
by Haeckel, loc. cit. Canossa Coll., Purch. 1903.

longitudinal series; splenial dentition consisting of three longitudinal series, the innermost the largest. Neural and hæmal arches of axial skeleton expanding and interlocking with digitations, thus encircling the notochord. Fin-rays robust, closely articulated and divided distally. Pelvic fins present; dorsal and anal fins much elevated in front, becoming low and fringe-like behind, the former occupying at least the hinder half of the back, and the latter somewhat shorter, arising more posteriorly; caudal fin fan-shaped, having a convex hinder margin. Scales delicate, ornamented with tubercles or rugæ, usually covering only the anterior half of the trunk in advance of the median fins, though sometimes partly extended over the caudal region; ventral ridge-scales with long, diverging processes extending upon the flank.

Palæobalistum orbiculatum, Blainville.

1796. *Diodon orbicularis,* G. S. Volta, Ittiolit. Veronese, p. clxviii, pl. xl.
1803. *Balistes,* B. Faujas St. Fond, Essai de Géologie, vol. i. p. 132, pl. vi.
1818. *Palæobalistum orbiculatum,* H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 339.
1833–44. *Pycnodus orbicularis,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17, pt. ii. p. 190.
1856. *Palæobalistum orbiculatum,* J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 229, pl. x.

Type. Imperfect, erroneously restored fish; Paris Museum of Natural History.

The type species, attaining a length of about 0·25. Maximum depth of trunk equalling about four-fifths of the length of the head and trunk without caudal fin; head with opercular apparatus occupying slightly more than one-quarter of the total length of the fish. Vertebral axis at origin of dorsal fin nearly midway between the dorsal and ventral borders of the fish. Teeth of inner or principal series of mandible much broader than long; those of the second series similar in shape, but about half as large; those of the outer series relatively small and hemispherical. Dorsal and anal fins not acuminate in front, but gradually diminishing in height backwards; the dorsal fin, with 67 rays, occupying somewhat more than one-half of the back, the anal fin shorter, with 56 rays. Scales confined to the anterior half of the trunk in advance of the median fins.

Form. & Loc. Upper Eocene: Monte Bolca, N. Italy.

Not represented in the Collection.

Palæobalistum ponsorti, Heckel.

1856. *Palæobalistum ponsortii,* J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 236, pl. xi. figs. 1–15.

Type. Nearly complete fish ; Court Museum, Vienna.

A small species, attaining a length of about 0·2. Maximum depth of trunk equalling about three-quarters of the length of the head and trunk without caudal fin ; head with opercular apparatus occupying about one-quarter of the total length of the fish. Vertebral axis at origin of dorsal fin slightly above the middle of the trunk. Teeth of inner or principal series of mandible much broader than long ; those of the second series scarcely broader than long ; those of the outer series smaller and antero-posteriorly elongated. Dorsal and anal fins not acuminate in front, but gradually diminishing in height backwards ; the dorsal fin with 65 rays, occupying about two-thirds of the back, the anal fin with over 50 rays. Hinder margin of caudal fin slightly sinuous. Scales confined to the anterior half of the trunk in advance of the median fins.

Form. & Loc. Upper Cretaceous : Marne, France.

All the following specimens were obtained from the uppermost chalk of Mont Aimé, near Chalons-sur-Marne, in association with "*Lates heberti.*"

28292 a. Fine specimen 0·107 in length, apparently not distorted, showing the paired fins. *Purchased,* 1851.

28292. Twelve specimens variously preserved, the large ones fragmentary and one small example much distorted. *Purchased,* 1851.

P. 1638. Well-preserved fish 0·125 in length. *Egerton Coll.*

Palæobalistum goedeli, Heckel.

1856. *Palæobalistum goedelii,* J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 234, pl. ii. figs. 3–8.

1887. *Palæobalistum gœdelli,* J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. p. 496, pl. xxii.

1887. *Palæobalistum ventralis,* J. W. Davis, *ibid.* p. 499, pl. xxiii. [Distorted fish ; British Museum.]

Type. Caudal portion of a fish ; Court Museum, Vienna.

A large species, attaining a length of about 0·3. Maximum depth of trunk equalling about three-quarters of the length of the head and trunk without caudal fin ; head with opercular apparatus occupying considerably more than one-quarter of the total length of

1890. Pycnodus (Palæobalistum) Bonsorti, A. Gaudry, Enchaînem. — Fossiles Secondaires, p. 159, fig. 258.

1898. Palæobalistum bonsorti, F. Priem, Bull. Soc. Géol. France [3] vol. xxvi. p. 401, pl. xi. fig. 2.

1917. Palæobalistum bonsorti (? = Pycnodus), A. S. Woodward, Geol. Mag. [6] vol. iv. p. 387.

28292. Supratemporal cavity noticed Geol. Mag. 1917, p. 387.

P. 1638. Supratemporal cavity noticed Geol. Mag. 1917, p. 387.

1907. Palæobalistum goedeli, E. Hennig, Centralbl. f. Min. p. 362, text-fig. 1.

1907. — ventralis, E. Hennig, ibid. p. 363, fig. 2.

the fish. Vertebral axis at origin of dorsal fin much above the middle of the trunk. [Teeth not satisfactorily known.] Dorsal and anal fins acuminate in front, rapidly becoming low and fringe-like, with distant fin-rays behind; the dorsal fin with 53 rays, occupying nearly two-thirds of the back, the anal fin with slightly less than 50 rays. Hinder margin of caudal fin deeply sinuous. Scales robust on the anterior half of the trunk, but extended in more delicate form over the middle of the caudal region.

This species is distorted in such various ways when fossilized, that it seems probable the body was less laterally compressed than in *P. orbiculatum* and *P. ponsorti*. The form of the median fins and the extension of the squamation over the caudal region may even be regarded as necessitating the removal of the fish from the genus *Palæobalistum*.

Form. & Loc. Upper Cretaceous: Mt. Lebanon, Syria.

P. 4001, P. 4781. A fine specimen, in counterpart, somewhat shortened and deepened by crushing; Hakel, near Djebail. The head is much fractured, but exhibits the large backwardly-directed process from the hinder margin of the cranial roof-bone in the parietal region. The expanded neural and hæmal arches of the axial skeleton of the trunk are distinct; the laminar expansion on the neural and hæmal spines is confined to their front margin, and there is no interlocking. The supports bearing the anterior elevated rays of the dorsal and anal fins are strengthened by considerable wings. Some of the delicate ribs of the squamation on the middle of the caudal region are also preserved. *Lewis Coll.*

P. 61, P. 62. Imperfect head and trunk in counterpart, the vomerine teeth, as exposed in side view, figured by Davis, *loc. cit.* pl. xxiii. fig. 1 *a*; Hakel. Though the skull is displayed in side view, it is so much crushed and fractured that it does not afford any osteological information of importance. The remarkable interlocking of the laminar expansions of the neural and hæmal spines described below in no. P. 4002, is shown by delicate impressions not only in the caudal region but also in some of the neural arches of the abdominal region. The external bones and scales are punctate. Some of the scales are preserved on the caudal region, but they do not extend quite to the base of the median fins; they are shown to be quite minute as

they approach the anal fin, and the vertical series here are bent forwards. *Lewis Coll.*

P. 63. Another imperfect head and trunk, wanting caudal fin; Hakel. *Lewis Coll.*

P. 63 a. A smaller specimen, displaying the characteristic form of the dorsal and caudal fins; Hakel. *Lewis Coll.*

P. 4002. Imperfect fish wanting dorsal region, but displaying the caudal and anal fins, apparently the "second specimen" described as *P. ventralis* by J. W. Davis, *loc. cit.* p. 500; Hakel. The large pectoral fins are indicated, and the diminutive pelvic pair appears not far in advance of the anal. In the caudal region both the neural and hæmal arches are shown to be firmly united by their laminar expansions; each spine exhibiting the lamina behind and in front, and this interlocking with the next lamina by a jagged suture. The external ornament of the scales consists only of fine pittings, and the ventral ridge-scales do not appear to have been serrated. The delicate squamation of the caudal region extends to the base of the anal fin for at least two-thirds of its length, being here finely subdivided and arranged in reflexed series as in no. P. 61. *Lewis Coll.*

39231. Head and anterior portion of trunk; Hakel. There are distinct traces of the interdigitating laminar expansions on the neural and hæmal arches. *Tristram Coll.*

39232. Lower half of trunk with caudal fin, in counterpart; Hakel. In the pectoral fin there are impressions of basals to the number of 7 or 8. The caudal fin and parts of the anal are especially well preserved; the small scales extend quite to the base of the latter. Three of the hæmal spines within the caudal fin exhibit a large triangular expansion. *Tristram Coll.*

The following specimen is regarded by J. W. Davis as the type of a distinct species, which he names *Palæobalistum ventralis* (Trans. Roy. Dublin Soc. [2] vol. iii. 1887, p. 499, pl. xxiii.). It is described as differing from *P. goedeli* in the form of the body and the teeth (the latter being seen in no. P. 61 catalogued above, which Davis regards as likewise *P. ventralis*). The most reasonable explanation of the differences noted seems to be, that the undermentioned

1907. Palaeobalistum flabellatum, A.S. Woodward,
Geol. Mag. [5] vol. iv. p. 193, pl. vii. fig. 3.
1936. Palaeobalistum flabellatum, J.C. Maury, p. 49
pl. 1

Pal. libanicum s.n. Kramb. Gorj. 1895 Hjela Lugost
Akad. 16 p. 33 pl. viii f. 1.

Palaeobalistum bassanii, G. d'Erasmo, Paleont.
Italica, vol. xx (1914), p. 71, pl. viii. — Cretaceous;
Pietraroia,

Palaeobalistum dossantosi, s.n. C.J. Maury, 1930,
Mon. Serv. geol. Brasil, VIII. p. 89, pl. ii f. 9. U. Cret
Brazil. [rom. deal.].

Palaeobalistum guttulosum s.n. Cenom.
Morocco, Arambourg 1935. Bol. Mem. Serv. Geol.
Maroc 18, p 9, fg. 3-13, pl. i-iv. Fish

fossil is extremely distorted by crushing; while the two specimens compared as regards the dentition, exhibiting only the series in side-view, do not display homologous teeth.

P. 65. Obscurely preserved and distorted fish in hard limestone, described and figured, *loc. cit.*; Hakel. The amount and direction of distortion are indicated by the displacement of the lobes of the tail. *Lewis Coll.*

Palæobalistum flabellatum (Cope).

1886. *Pycnodus flabellatus*, E. D. Cope, Proc. Amer. Phil. Soc. vol. xxiii. p. 6.

1890. *Palæobalistum flabellatum*, A. S. Woodward, Geol. Mag. [3] vol. vii. p. 394.

Type. Imperfect fish; Cope Collection, Philadelphia.

A species attaining a length of about 0·2, differing from other forms (according to Cope's description) in its relatively short anal fin. Dorsal fin comprising 53, anal fin only 24 rays.

The neural spines are shown to be united by interdigitations of their laminar expansions, as described above in *P. goedeli*. The circumstance that only four basal bones are recognizable in the pectoral fin, is probably due to imperfection in preservation; there being distinctly not less than seven in *P. goedeli* (no. 39232).

Form. & Loc. Cretaceous: Province of Sergipe del Rey, Brazil. Not represented in the Collection.

Fragments apparently of a species of *Palæobalistum* from the Cretaceous of Comen, Istria, are also described by R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. lvi. pt. i. (1867), p. 183.

Genus **PYCNODUS,** Agassiz.

[Poiss. Foss. vol. i. 1833, pl. G. fig. 1 (name and fig. only), vol. ii. pt. i. 1833, p. 16, and pt. ii. 1844, p. 183.]

Syn. *Periodus*, L. Agassiz, *ibid.* vol. ii. pt. ii. 1844, p. 201.

Trunk deeply fusiform, gradually passing into a slender caudal pedicle. Head- and opercular bones externally rugose and punctate; teeth smooth, or with a slight apical pit and feeble rugosity; oral surface of vomer slightly convex from side to side, with teeth in five longitudinal series; splenial dentition comprising three series of teeth, the innermost the largest. Neural and hæmal arches of the axial skeleton of trunk expanding to encircle the notochord. Fin-rays delicate, spaced, articulated and somewhat

divided distally. Pelvic fins present; dorsal and anal fins low and fringe-like, the former occupying the greater part of the back and the latter much shorter, arising more posteriorly; caudal fin with slightly excavated hinder border. Scales covering the anterior part of the body in advance of the median fins.

Pycnodus platessus (Blainville).

1796. *Coryphæna apoda*, G. S. Volta, Ittiolit. Veronese, p. cxlvii, pl. xxxv. fig. 1.

1818. *Zeus platessus*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 356.

1833–44. *Pycnodus platessus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 17, pt. ii. p. 185, pl. lxxii. figs. 1, 2 (*non* figs. 3, 4).

1856. *Pycnodus platessus*, J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. pp. 204, 226, pl. viii. figs. 5, 7.

Type. Nearly complete fish; Paris Museum of Natural History.

The type species, attaining a length of about 0·3. Maximum depth of trunk equalling half the length of the fish exclusive of the caudal fin; head with opercular apparatus occupying about one-quarter of the total length. Teeth of the splenial bone smooth, the outermost indented; the inner or principal series equalling in breadth the two flanking series, of which the inner comprises teeth broader than long, the outer nearly round teeth. Dorsal fin occupying somewhat less than three-quarters of the total length of the back, arising almost at the highest point.

Form. & Loc. Upper Eocene: N. Italy.

38000. Plaster cast of type specimen; Monte Bolca, near Verona.
Purchased, 1864.

41083. Imperfect specimen, wanting extremity of caudal region, displaying the right splenial dentition; Monte Bolca.
Purchased, 1868.

Pycnodus gibbus, Agassiz.

1796. *Coryphæna apoda, var.*, G. S. Volta, Ittiolit. Veronese, p. cxlvii, pl. xxxv. fig. 2.

1796. *Diodon reticulatus*, G. S. Volta, *ibid.* p. xciv, pl. xx. fig. 3.

1844. *Pycnodus gibbus* = *Pycnodus platessus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 185, pl. lxxii. figs. 3, 4.

1856. *Pycnodus gibbus*. J. J. Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xi. p. 226, pl. viii. figs. 3, 4, 6.

Type. Nearly complete fish.

A small species, attaining a length of about 0·15. Maximum depth of trunk slightly exceeding half the total length of the fish

Pycnodus sp. 1930, Ann. Soc. Sci. nat. Charente-inférieure, n.s. I. iv. p. 101. pl. 3 f. 9. [Coralliang].

1905. *Pycnodus platessus*, E. Stromer, Beitr. Paläont. Österr.-Ungarns, vol. xviii. p. 186 [dentition of fig? specimen].

1917. *Pycnodus platessus*, A.S. Woodward, Geol Mag. [6] vol. iv. p. 387, pl. xxiv.

41083. Pharyngeal teeth noticed by A.S.W. Geol. Mag. 1917, p. 387.

1911. C.R. Eastman, Mem. Carnegie Mus. iv. pl. xcv. f. 3.

Pycnodus apodus

P.1633 shows comminuted shells in stomach;
des: & fig: A.S.W., Geol. Mag. 1917, p. 387, pl. xxiv.
P.1634 shows supratemporal vacuity, noticed ibid.
P.4386 shows pharyngeal teeth, noticed ibid.
P. 4382

1920. Pycnodus toliapicus, A. Bell, Ann. Rep. Yorks. Phil. Soc. 1919, p. , pl. ii. fig. 16. [Splenial; York Mus.]
?1922. Pycnodus toliapicus, G. D'Erasmo, Catal. Pesci Fos. d. Tre Venezie (Mem. Ist. Geol. R. Univ. Padova, vol. vi.), p. 61, pl. vi. figs. 11–16.
??1929. P. toliapicus, R. Sarra, Rivista ital. paleont. xxxv. p. 10.
[Isol. Gestn. in del. Cretac.: Basilicata
1950. ? cf. L. Casei p. 23 pl. ii f. 6.

38825. Both figs. A.S. Woodward, Paleont. Indica, n.s. vol. iii. no. 3 (1908), pl. i. fig. 11.

(including the caudal fin); head with opercular apparatus occupying somewhat more than one-quarter of the total length. Teeth and fins apparently as in the type species.

This form was regarded by Agassiz, in his final description, as the young of *P. platessus*. It is here assigned to a distinct species on the authority of Heckel, who refers to three small specimens of *P. platessus* as showing the same proportions of the trunk as the typical adult.

Form. & Loc. Upper Eocene: N. Italy.

P. 7459. Specimen 0·135 in length, displaying proportions of splenial teeth and remains of paired fins; Monte Bolca, near Verona. ~~*Purchased.*~~ History unknown

P. 1633–4. Two smaller specimens, the second imperfect dorsally and wanting the hinder half of the caudal region; Monte Bolca. *Egerton Coll.*

P. 4386. More imperfect fish showing the hollowed crown of the splenial teeth; Monte Bolca. *Enniskillen Coll.*

P. 1632, P. 3760. Small specimen, 0·06 in length, in counterpart; Monte Bolca. *Egerton and Enniskillen Colls.*

Pycnodus toliapicus, Agassiz.

1839–44. *Pycnodus toliapicus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 196, pl. lxxii. *a.* fig. 55.

1877. *Pycnodus toliapicus*, Sir P. Egerton, Geol. Mag. [2] vol. iv. p. 53.

Type. Imperfect splenial dentition; Oxford Museum. Inst. Geol. Univ. Neuchâtel

A large species, known only by the splenial dentition. Teeth of inner or principal series on the splenial bone attaining a width more than twice as great as their length, equalling the two flanking series in breadth and the latter almost in the same plane; teeth of second series considerably broader than long, with rugose and slightly indented crown; those of the outer series smaller, nearly as long as broad, similarly rugose and indented.

Form. & Loc. Lower Eocene: London Basin. ? Lutetian, Italy.

38825–26. Splenial dentition, imperfect and abnormal on the left side, the anterior principal teeth being subdivided into small teeth; London Clay, Isle of Sheppey. This specimen is described by Egerton, *loc. cit.* p. 53. *Bowerbank Coll.*

ZZ. 12 (Cracherode Catalogue). Smaller left splenial dentition; Sheppey. *Cracherode Bequest.*

P. 4721. Well-preserved left splenial bone, with worn dentition; Sheppey. *Purchased*, 1884.

P. 3759. Smaller more abraded specimen; Sheppey. *Enniskillen Coll.*

The following specimens probably pertain either to this species or to *Pycnodus bowerbanki*:—

P. 610. Ethmo-vomerine region of skull with vomerine dentition, described and figured as the type specimen of *Pycnodus pachyrhinus*, Egerton, Geol. Mag. [2] vol. iv. 1877, p. 54, pl. iv. figs. 1, 2; London Clay, Isle of Sheppey. The fragment of bone marked *s* in Egerton's figure is now wanting. *Egerton Coll.*

P. 170. Portion of similar vomerine dentition, much worn; Sheppey. *Purchased*, 1880.

Pycnodus koenigi (Agassiz).

1839–44. *Periodus koenigii*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 201, pl. lxxii. *a*. figs. 61, 62.
1850. *Periodus koenigii*, F. Dixon, Geol. Sussex, p. 205, pl. x. fig. 13.
1877. *Periodus koenigi*=*Pycnodus toliapicus*, Sir P. Egerton, Geol. Mag. [2] vol. iv. p. 53.
1890. *Periodus koenigii*=*Pycnodus toliapicus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 173.

Type. Right splenial dentition; British Museum.

The type species of *Periodus*, known only by the splenial dentition, which is now usually assigned to *P. toliapicus*. From the latter, however, it differs in the outer row of splenial teeth being tilted considerably at their outer border and in the relatively longer form of the teeth of the second series.

Form. & Loc. Middle Eocene: Sussex; Belgium. Lutetian, Bavaria

25697. Type specimen; Bracklesham Beds, Bracklesham Bay, Sussex. *Dixon Coll.*

42848. Imperfect left splenial, with worn dentition; St. Pierre à Gand. *Van Breda Coll.*

P. 3752. Imperfect left splenial with dentition, perhaps an abnormal example of this species; Bracklesham Beds, Bracklesham Bay. *Enniskillen Coll.*

Pycnodus mokattamensis Priem.

1897. Pycnodus mokattamensis, F. Priem, Bull. Soc. Géol. France [3] vol. xxv. p. 217, pl. vii. figs. 9-14.

1899. Pycnodus mokattamensis, F. Priem, loc. cit. vol. xxvii. p. 241, pl. ii. fig. 1.

1922. Pycnodus mokattamensis, M. Leriche, Bull. Soc. Belge Géol. vol. xxxi. p. 208, pl. iv. fig. 6.

Syst. Vomerine dentition; Fourtau Coll.

P.11273. Portion of right splenial dentition & one incisive tooth, probably of this species; Mokattam. Pres. G. Foster Smith, Esq., 1914.

P. affinis, Matheron = Mesodon matheroni, F. Priem, Bull. Soc. Géol. France [4] vol. xvi (1916), p. 290, pl. viii. figs. 6-9, ?10, 11. P. matheroni nom. nov. W.W. Fowler 1958 Not. Nat. 310:3.

P. comminutus, s.n. O.P. Hay 1916, Bull. Univ. Texas no 71. p. 3, pl. 1. f. 1. L. Creek. Texas. R. Splenial: Baylor Univ.

P. gosseleti = Chimaera gosseleti, M. Leriche, Mém. Mus. Roy. Hist. Nat. Belg. vol. v (1910), Poiss. Oligoc. Belg. p. 302, pl. xix. fig. 51.

Pycnodus bowerbanki, Egerton.

1877. *Pycnodus bowerbanki,* Sir P. Egerton, Geol. Mag. [2] vol. iv. p. 52, pl. iii. fig. 2.

Type. Right splenial dentition ; British Museum.

A very large species, known only by the splenial dentition. Teeth of inner or principal series on the splenial bone attaining a width considerably more than twice as great as their length, and not quite equalling the two flanking series in breadth ; teeth of the second series about twice as broad as long, and those of the outermost series smaller but considerably broader than long.

Form. & Loc. Lower Eocene : London Basin.

38824. Type specimen ; London Clay, Isle of Sheppey.
Bowerbank Coll.

The following species has also been determined on the evidence of the dentition, but it is not represented in the Collection :—

Pycnodus faba, H. von Meyer, Neues Jahrb. 1847, p. 186, and Palæontogr. vol. i. (1848), p. 152, pl. xx. figs. 3, 4.—Eocene (Ironstone); Altstadt, near Mösskirch, Baden. [Left splenial.]

The following names have also been given to detached teeth or to generically and specifically indeterminable fragments of dentition :—

Pycnodus affinis, P. Matheron (*non* Pictet), Rech. Paléont. Midi France (1878), pl. C–17, fig. 5 (figures only) ; E. Arnaud, Bull. Soc. Géol. France, [3] vol. x. (1882), p. 133.—Lower Cretaceous (Urgonian); Orgon, Apt, Vaucluse.

Pycnodus carolinensis, E. Emmons, Rep. Geol. Surv. N. Carolina (1858), p. 244, fig. 96.—Miocene ; North Carolina.

Pycnodus cylindricus, Pictet & Campiche, Foss. Terrain Crét. St. Croix, pt. i. (1858), p. 58, pl. viii. figs. 1–20.—Neocomian ; Switzerland. [Campiche Collection.]

Pycnodus dutemplei, M. Rouault, Comptes Rendus, vol. xlvii. (1858), p. 100.—Miocene ; St. Juvat, near Dinan, Côtes-du-Nord, France.

Pycnodus funkianus, H. B. Geinitz, Abh. naturw. Ges. Isis, Dresden, 1883, p. 39, pl. ii. fig. 4.—Phosphate Beds (Middle or Upper Eocene); Helmstedt, Brunswick.

Pycnodus gosseleti, T. C. Winkler, Archiv. Mus. Teyler, vol. v. (1880), p. 82, woodc. figs. 6, 7.—Oligocene ; Limbourg. [Probably not Pycnodont.]

Pycnodus hartlebeni, F. A. Roemer, Verstein. Norddeutsch. Kreidegeb. (1840), p. 109.—Purbeckian (Hilsconglomerat); Osterwald.

Pycnodus latior, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1833), p. 17, pt. ii. (1844), p. 199. Figure by Faujas St. Fond, Hist. Nat. Mont. St.-Pierre, Maestricht (1799), pl. xix. fig. 2. —Danian; Maastricht, Holland.

Pycnodus mitratus, F. A. Quenstedt, Handb. Petrefakt. (1852), p. 214, pl. xvi. figs. 11, 12, and Der Jura (1858), p. 782, pl. xcvi. fig. 29.—Upper Corallian; Schnaitheim, Würtemberg. [Prehensile tooth; Tübingen University Museum.]

Pycnodus obliquus, Pictet & Campiche, *op. cit.* pt. i. (1858), p. 67, pl. viii. fig. 26.—Upper Gault; St. Croix, Switzerland. [Fragment of splenial; Campiche Collection.]

Pycnodus podolicus, Rogowicz (described in Russian Memoir on Fossil Fishes, Kieff, 1860), quoted by E. von Eichwald, Leth. Rossica, vol. ii. (1868), p. 1214.—Derived fossils in Alluvium; Kieff, Russia.

Pycnodus ponticus, E. von Eichwald, Leth. Rossica, vol. iii. (1853), p. 322.—Tertiary; Odessa.

Pycnodus pyriformidens, G. G. Gemmellaro, Studi Paleont. Fauna Calc. *Terebratula janitor* N. Sicilia, pt. i. (1868), p. 1, pl. i. figs. 1–6.—Kimmeridgian; Favara, Villabate, N. Sicily. [Specifically indeterminable teeth; Geological Museum, University of Palermo.]

Pycnodus rochebruni, H. Coquand, Descript. Géol. etc., Départ. Charente, vol. ii. (1860), p. 97.—Senonian; Sillac, Charente, France.

Pycnodus soluntinus, G. G. Gemmellaro, *op. cit.* p. 4, pl. i. figs. 18–25.—Kimmeridgian; Favara. [Specifically indeterminable teeth; Geological Museum, University of Palermo.]

Pycnodus subæquidens, F. J. Pictet, Rept. & Poiss. Foss. Jura Neuchâtelois (1860), p. 66, pl. xiv. figs. 2, 3.—Kimmeridgian; Chaux-du-Milieu, Neuchâtel.

Pycnodus transitorius, G. G. Gemmellaro, *op. cit.* pt. i. (1868), p. 2, pl. i. figs. 7–14.—Favara. [Specifically indeterminable teeth; Geological Museum, University of Palermo.]

A portion of a fish from the Portlandian of Savonnières-en-Perthois, Meuse, described under the name of *Pycnodus anceps* (J. Cornuel, Bull. Soc. Géol. France, [3] vol. xi. 1883, p. 21, pl. ii.), probably does not belong to the Pycnodontidæ.

P. praecursor sp. nov. Eocene Congo Stanleyville Basin 1949 p. 212 pl. xvii f. 1, 3 ? 4-5, 7. Paleocene Cabinda, Cassia 1960 Ann. Mus. Congo Belge A III 1 (2) pp. 23 pl. iii f. 2.

Pycnodus lametae, A. S. Woodward, Paläont. Indica, n.s. vol. iii. no. 3 (1908), p. 5, pl. i. fig. 10. — Lameta Beds; Dongargaon, Raipur, India. [Skull; Geol. Surv. India.]

Pycnodus munieri, F. Priem, Bull. Soc. Géol. France [4] vol. ii (1902), p. 444, text-fig. 1. — Eocene; Corriza (Aude). [Vomerine dentition; Marcel de Serres Coll.]. M. Leriche, Ann. Univ. Lyon, n.s. I. Sciences, fasc. 22, p. 7, pl. i. fig. 4.

Pycnodus bellei, F. Priem, Bull. Soc. Géol. France [4] vol. iii (1903), p. 402, pl. xiii. fig. 5. — Eocene; Gafsa, Tunis. [Splenial; School of Mines, Paris.] sp. G. D'Erasmo 1934a, p. 8, pl. xxiv² f 6 (ment.).

Pycnodus taltani White s.a.

Pycnodus planidens n.n. C. P. Hay 1916 Bull. Univ. Texas no. 71, p. 7 L. Cret. Texas. L. Splenial U.S.N.Mus.

Pycnodus savini, F. Priem, Bull. Soc. Géol. France [4] vol. ii (1902), p. 46, text-fig. 2. — M. Eocene; Villespy, near Castelnaudary (Aude). [Vomerine dentition.]

{ P. v. cf. variabilis E. Stromer 1935, p. 39, tf. 7. Lamlem, Nigeria.
Pycnodus variabilis, var. togoensis, E. Stromer, Zeitschr. deutsch. geol. Ges. vol 62, (1910) p. 485, text-fig. 2, pl. fig. 14. — Lower Tertiary; Adabion, South Togo, German West Africa.

Pycnodus variabilis, E. Stromer, Beitr. Paläont. Österr.-Ungarns, vol xviii (1905), p. 190, pl. xvi. figs. 33-37. — U. Eocene; Mokattam, Cairo. [Splenial dentition.]

Pycnodus sp., F. Priem, Poiss. Fos. Bassin Parisien (Publ. Ann. Paléont. 1908), p. 110, text-fig. 54. — Lutetian; Chaumont-en-Vexin, Oise. [Portion of splenial.]

Pycnodus sp. G. de Alessandri, Mem. Soc. Ital. Nat. Sci, vol. vi (1897) pt. 1. p. 28 pl. figs 7. [Tort. Miocene; Piedmont.]

Acrotemnus yangaarus n. v. Chatsworth Coll
Chatsworth Casier 1949 p. 211 pl. xx f. 23.

A. splendens. See p. 284.

1909. 12. Acrotemnus faba, A. S. Woodward, Syn. Fishes English Chalk (Pal. Soc.), p. 169, pl. xxxiv. fig. 6; p. 252.
1943. A. f. Crambourg & Sbeaud Bull. y Dir. Mines A.O. p. 41 pl. ii. f. 10-17. & Cat. Niger.

4584. See both figs. loc cit. 1909.

1901. Pycnodus(?) scrobiculatus, M. Leriche, Ann. Soc. Géol. Nord, vol xxx. p. 162, pl. v. fig. 18.
1909. Pycnodus scrobiculatus, A. S. Woodward, Syn. Fishes English Chalk (Pal. Soc.), p. 168.
1908. Pycnodus aff. scrobiculatus, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont.), p. 60, text-fig. 21.

GENERICALLY INDETERMINABLE CRETACEOUS PYCNODONTS.

The following species represented in the Collection have been founded upon very fragmentary evidence and cannot as yet be generically determined.

Acrotemnus faba, Agassiz.

1837–44. *Acrotemnus faba,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 203, pl. lxvi. *a.* figs. 16–18.
1887. *Cœlodus faba,* K. A. von Zittel, Handb. Palæont. vol. iii. p. 249.

Type. Group of five teeth; British Museum.

A generic and specific name based upon the specimen mentioned below. The teeth are smooth and bean-shaped, each with a sharp, keel-like coronal summit overhanging a slight indent which has a feebly-crimped inferior margin. They may perhaps be the principal lower teeth of a species of *Cœlodus.*

Form. & Loc. Senonian: Sussex.

4584. Type specimen; Chalk, Lewes. The largest tooth measures 0·014 in width. *Mantell Coll.*

Pycnodus scrobiculatus, Reuss.

1845. *Pycnodus scrobiculatus,* A. E. Reuss, Verstein. böhm. Kreideform. pt. i. p. 10, pl. iv. figs. 15–25.
1845. *Pycnodus rostratus,* A. E. Reuss, *ibid.* p. 10, pl. iv. fig. 37.
1845. *Pycnodus semilunaris,* A. E. Reuss, *ibid.* p. 10, pl. iv. figs. 43–45.
1856. *Pycnodus scrobiculatus,* C. E. Fischer, Allg. deutsche Nat. Zeit. n. s. vol. ii. p. 138, figs. 8–16.
1856. *Ctenoptychius*?, C. E. Fischer, *ibid.* p. 138, figs. 17–20.
1874. *Pycnodus semilunaris,* St. Zarecznego, Sprawozd. Komisyi. Fizyjograf. Galicyi, vol. viii. p. (128), pl. i. fig. 4.
1875. *Pycnodus scrobiculatus,* H. B. Geinitz, Palæontogr. vol. xx. pt. i. p. 301, pl. lxv. figs. 22–32.
1878. *Pycnodus scrobiculatus,* A. Fritsch, Rept. u. Fische böhm. Kreideform. p. 22, pl. ii. figs. 6, 7.
1893. *Pycnodus scrobiculatus,* A. S. Woodward, Geol. Mag. [3] vol. x. p. 492, pl. xvii. fig. 7.

Type. Detached teeth.

The teeth of this form are tumid and coarsely punctate, apparently almost conical when unworn. They are of very small size, and have hitherto been found arranged only in three longitudinal series on a narrow vomer. The median and lateral teeth are about equal in size, and the latter are truncated at their outer border. Boulonnais;

Form. & Loc. Cenomanian (Lower Plänerkalk): Kosstitz, Bohemia; Galicia. Senonian: Sussex and Kent; Loir-et-Cher, France.

49804. Worn vomerine dentition 0·011 in maximum width, noticed in Geol. Mag. [3] vol. x. p. 492; Chalk, Southeram, Sussex. *Capron Coll.*

P. 322. A comparatively minute vomerine dentition, figured *ibid.* pl. xvii. fig. 7; Chalk, Charing, Kent. *Harris Coll.*

Phacodus punctatus, Dixon.

1850. *Phacodus punctatus*, F. Dixon, Geol. Sussex, p. 371, pl. xxx. fig. 16.

Type. Worn teeth; British Museum.

A generic and specific name based upon the indeterminable fossil mentioned below.

Form. & Loc. Senonian: Sussex.

25829. The type specimen, comprising three associated principal teeth and three lateral teeth, all worn and thus exhibiting a punctate surface; Chalk, Lewes. *Dixon Coll.*

The following examples of vomerine bones probably belong either to *Cœlodus* or to *Anomœodus*:—

49803. Imperfect middle portion of vomerine dentition, with closely arranged, broad, smooth median teeth; Chalk, Dorking, Surrey. *Capron Coll.*

P. 3758. Vomerine dentition, described and figured in Geol. Mag. [3] vol. x. (1893), p. 492, pl. xvii. fig. 2; Upper Greensand, Isle of Wight. *Enniskillen Coll.*

P. 7239. Portion of vomer much resembling specimen figured *ibid.* pl. xvii. fig. 4; Cambridge Greensand, Cambridge. *Jesson Coll.*

46364. Portion of small vomer, with three series of teeth; Cambridge Greensand. *Cunnington Coll.*

Several generically indeterminable examples of the vomerine dentition of Cretaceous Pycnodonts are also known. Specimens from the Cambridge Greensand, in the Woodwardian Museum, Cambridge, have been described and figured by the present writer (Geol. Mag. [3] vol. x. 1893, p. 492, pl. xvii. figs. 3, 4); and the following have received names:—

Pycnodus (*Typodus*) *cotteaui*, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 36, pl. ii. fig. 1 (? also splenial, pl. i. fig. 3).—Upper Neocomian: Auxerre, Yonne, France.

49804. Desc. & fig.d as Gyrodus? cretaceus.
A.S.W. Foss. fish. Eng. Chalk p.168 pl. XXXV fig. 7.

1909. Phacodus punctatus, A.S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 168, pl. XXXIV. figs. 7, 8.
1952. Ph. pus. var. africanus nov. C. Arambourg p. 227 – pl 37 f 27,28 [mae Cr. N. Africa].

25829. Desd & fig? loc. cit. p. 169, fig. 7.

49803. Noticed loc. cit. p. 169.

Pycnodont tail from L. Oligocene, Blocksberg, Hungary, described by A. Koch, Földtani Közlöny, vol. xxxiv (1904), p. 334 (367).

U. cotteaui is rower from U. Corallian, Dépt. Yonne. Uranoplosus is considered provisionally as subgenus of Mesodon by H. E. Sauvage, Bull. Soc. Géol. France [4] vol. III i (1901), p. 547.

J. Cornet, Bull. Soc. Géol. Belg. xxxvi (1909), p. 224.

Some are pharyngeal teeth (A. S. Woodward, Geol. Mag. [6] vol. iv, 1917, p. 387).

Pycnodus disparilis, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 614, pl. xi. figs. 19, 20.—Neocomian : Wassy, Haute Marne. [? *Gyrodus*.]

Pycnodus heterodon, L. Didelot, Bull. Soc. Géol. France, [3] vol. iii. (1875), p. 254, pl. vi.—Middle Neocomian; near Aix-les-Bains, Savoy.

Pycnodus heterotypus, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 613, pl. xi. figs. 12–18.—Neocomian ; Wassy and Vallerest, Haute Marne.

Pycnodus irregularis, H. E. Sauvage (*non* Quenstedt), Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 44, pl. i. fig. 7.—Cenomanian ; Seignelay, Yonne, France.

Pycnodus quadratifer, J. Cornuel, Bull. Soc. Géol. France, [3] vol. v. (1877), p. 615, pl. xi. figs. 21, 22.—Neocomian ; Wassy, Haute Marne.

Ellipsodus incisus, J. Cornuel, *ibid.* p. 617, pl. xi. figs. 26, 27.—Upper Neocomian ; Wassy. [Type of *Ellipsodus*, Cornuel.]

Uranoplosus arctatus, E. D. Cope, Journ. Acad. Nat. Sci. Philad. [2] vol. ix. (1894), p. 445, pl. xx. fig. 8.—Lower Cretaceous ; Oklahoma, U.S.A.

Uranoplosus cotteaui, H. E. Sauvage, Bull. Soc. Sci. Nat. Yonne, vol. xxxiii. pt. ii. (1879), p. 47, pl. i. fig. 1. [Type of *Uranoplosus*, Sauvage.]

Uranoplosus flectidens, E. D. Cope, *loc. cit.* (1894), p. 446, pl. xx. fig. 9.—Lower Cretaceous ; Oklahoma, U.S.A.

Other indeterminable Cretaceous teeth which seem to be Pycnodont are also named as follows :—

Sphærodus crassus, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1833), p. 15, pt. ii. (1844), p. 212, pl. lxxiii. figs. 101–108. Figures by Faujas St. Fond, Hist. Nat. Mont. St.-Pierre, Maestricht (1799), pl. xix. figs. 3, 5.—Danian ; Maastricht, Holland.

Sphærodus mitrula, L. Agassiz, *tom. cit.* pt. ii. (1844), p. 214, pl. lxxiii. figs. 71–73. —Greensand ; Regensburg, Bavaria.

Sphærodus tenuis, A. E. Reuss, Verstein. böhm. Kreideform. pt. i. (1845), p. 9.—Plänerkalk ; Bohemia.

The Cretaceous teeth commonly described under the provisional generic name of *Ancistrodon* (F. Roemer, *ex* Debey, MS., Kreidebild. Texas, 1852, p. 30) or *Ankistrodus* (L. G. de Koninck, Bull. Acad. Roy. Sci. Belg. [2] vol. xxix. 1870, p. 77) are also probably for the most part the prehensile teeth of Pycnodonts. Some of the Tertiary

forms, however, bear more resemblance to the pharyngeal teeth of certain bony fishes, as maintained by W. Dames (Zeitschr. deutsch. geol. Ges. vol. xxxv. 1883, p. 658).

Such teeth are exhibited in the front of the mouth of a specimen of *Xenopholis carinatus* from Mount Lebanon, in the Court Museum, Vienna; and the following specimens are preserved in the Collection :—

P. 7460. A comparatively large tooth, slightly constricted and crimped at the base of the crown; Chalk, Lewes.
Presented by Rev. T. Wiltshire.

49956. Smaller tooth, described and figured in Proc. Geol. Assoc. vol. x. (1888), p. 330, pl. i. fig. 10; Lower Chalk, Lewes.
Capron Coll.

P. 335. Still smaller dental crown; Chalk, Hart Hill, Charing, Kent. *Harris Coll.*

The following Cretaceous forms of these prehensile teeth have also been named :—

Ankistrodus splendens, L. G. de Koninck, Bull. Acad. Roy. Sci. Belg. [2] vol. xxix. (1870), p. 78, figs. 1–3.—Upper Senonian; Meudon, near Paris. [Geological Museum, University of Louvain.]

Ancistrodon libycus, W. Dames, Zeitschr. deutsch. geol. Ges. vol. xxxv. (1883), p. 663, pl. xix. figs. 6–8.—Senonian; Gassr-Dachel, Libyan Desert. [Palæontological Museum, Munich.]

Ancistrodon mosensis, W. Dames, *ibid.* p. 662, pl. xix. figs. 4, 5. —Senonian; Aix-la-Chapelle and Maastricht.

Ancistrodon texanus, W. Dames, *ibid.* p. 664. *Ancistrodon* sp. F. Roemer, Kreidebild. Texas (1852), p. 10, pl. i. fig. 10.—Senonian; Texas. [Geological Museum, University of Breslau.] T. of Gryphodon Hay 1899, amer. Naturalist 33, p. 790.

Gryphodon, Hay, 1899, substitute for Ancistrodon preoccupied in Snakes (See opp. p. bottom)

P. 7460. Desc. & fig. A. S. Woodward, Fos. Fishes English Chalk (Pal. Soc.), p. 169, pl. xxxv. fig. 8.

Ancistrodon splendens, F. Priem, Poiss. Fos. Bassin Parisien (Publ. Ann. Paléont. 1908), p. 64, text-fig. 26.
= Acrotemnus splendens, M. Leriche, Bull. Soc. Belge Géol. vol. xxv (1911), Proc. Verb. p. 162, pl. A.

Anc. libycus, K. A. von Zittel, Grundzüge Palaeont. (1895), p. 598, text-fig. 1570; A. Lucas, Palaeontogr. vol. xxx (1902), p. 319, pl. xxviii. fig. 1.

Ancistrodon sp., F. Priem, Poiss. Fos. Bassin Parisien (Publ. Ann. Paléont. 1908), p. 60, text-fig. 22. — Senonian; Sens, Yonne. [Coll. J. Lambert.]

Ancistrodon sp., F. Priem, Ann. Paléont. vol. vi (1911), p. 18, text-fig. 5. — Senonian; Dieppe.

† Family GIGANTODONTIDÆ. nov. Weiler 1936

Stromerichthys aethiopicus, S.T.S. n. Weiler, 1936 p. 26. Fig. 2, Pl. III. f. 7, 17, 20, 23. Fragmentarisch. Cenoman: Baharije. Stromer 1936, p. 45, Lf. 112. 16, 2.

? a Coelacanth Stromer. Vert. Palæont. II Edit. p. 589.

Incl. Macropristis p. 173.

Family EUGNATHIDÆ.

Trunk fusiform or elongate, not much laterally compressed. Cranial and facial bones moderately robust, externally enamelled, and opercular apparatus complete; mandibular suspensorium nearly vertical or inclined backwards, and gape of mouth wide; snout not produced; premaxillæ in contact mesially and usually separate; marginal teeth conical, and larger than the inner teeth. Notochord usually persistent, the vertebræ very rarely more than incomplete rings. Fin-rays robust, articulated and divided distally; fulcra conspicuous. Dorsal fin short and acuminate. Scales rhombic, sometimes with rounded postero-inferior angle.

Synopsis of Genera.

I. Vertebral ossifications wanting or in form of separate pleurocentra and hypocentra, sometimes fused into rings.

(*a*) Scales thick.

Trunk more or less elongated; marginal teeth large, inner teeth minute and clustered; dorsal fin in advance of anal; caudal fin forked; scales pectinated, not deepened on flank, narrow ventrally ..... *Eugnathus* (p. 286).

Ditto, but trunk deeper, vertebral elements usually more robust, and teeth smaller ..... *Heterolepidotus* (p. 304).

Trunk robust; dorsal fin in advance of anal; caudal fin forked; flank-scales not much deepened, ventral scales nearly or quite as deep as broad .... *Allolepidotus* (p. 315).

Trunk elegantly fusiform; external bones highly ornamented with ridges; marginal teeth very small and regular; dorsal fin in advance of anal; caudal fin forked; scales all narrow and elongated, marked with longitudinal furrows ..... *Ptycholepis* (p. 316).

(*b*) Scales thin.

Caudal pleurocentra and hypocentra never annular; marginal teeth large, splenial teeth smaller, but long, slender and clustered; dorsal fin in advance of anal; caudal fin forked; scales tuberculated and most with peg-and-socket articulation..... *Osteorachis* (p. 324).

Caudal pleurocentra and hypocentra never annular; marginal teeth large, splenial teeth much smaller and mostly in single series; dorsal fin in advance of anal; caudal fin forked; scales smooth or delicately pectinated, deeply overlapping ..... *Caturus* (p. 329).

Ditto, but dorsal fin opposed to anal .... *Callopterus* (p. 351).

Caudal pleurocentra and hypocentra in form of alternating complete rings; dentary teeth large, maxillary and splenial teeth much smaller and in a single close series; dorsal fin in advance of anal; caudal fin forked; scales deeply overlapping ..... *Eurycormus* (p. 352).

II. Vertebral ossifications in the form of solid discs.

External bones much ornamented and cranial roof without elevations; marginal teeth large and regular; scales thick, with feeble peg-and-socket articulation, not deepened on the flank, very narrow ventrally .... *Neorhombolepis* (p. 355).

III. Vertebral ossifications uncertain, but probably rings.

Much resembling *Neorhombolepis*, but differing especially in the development of a pair of elevations on the cranial roof immediately behind the eyes .. *Lophiostomus* (p. 358).

FURO

Genus **EUGNATHUS**, Agassiz.

[Poiss. Foss. vol. ii. pt. ii. 1844, p. 97.[1]]

Syn. *Lissolepis*, J. W. Davis, Ann. Mag. Nat. Hist. [5] vol. xiii. 1884, p. 448. non Peters 1872 (Repl.).

Isopholis, K. A. von Zittel, Handb. Palæont. vol. iii. 1887, p. 216.

Trunk elongate-fusiform. External bones feebly ornamented with tuberculations or rugæ; teeth relatively large and spaced on the dentary, smaller and more closely arranged on the margin of the upper jaw, minute and almost granular on the inner bones, in

[1] The name *Eugnathus* appears to have been first quoted, but without definition, by Sir P. Egerton, London & Edinb. Phil. Mag. [3] vol. viii. 1836, p. 368.

Eocuspathus Brough 1939.

Eocuspathus megalepis n.s.p.s. J. Brough 1939 Trias. Fish. Besano, p. 71, ff.s. 32-33. U1, pl. i f. 1-2. Trias: Lombardy [Fish, BM] (Resin?).

Orthocosmus cornutus, n.g.f.s. K. Weitzel, 1930. 'Museum u. Natur' (Frankf. a.M.) vol. LX, p. 1. p. 26, t-f. 5-6. - U. Jur. (Solnhofen slate.); Langenalbheim. [Fish; Senckenberg Mus.]. Parycomid s.e.p. 374.

Sinocuspathus Kuleichowensis g.f.s.n. m. Trias Kuleichow S.W. China, T.-T. Su 1959, Vert. Palas. 3, 4: 207, ff. 1 pl. ii figs 1-2. Fish, Acad. Sinica.

non Eugnathus Schaenherr 1833 Gen. Sp. Curc. 1, 12. 1834 [illegible]

Euro. J. Gistel, Naturgesch. Thierreichs, 1848. p. ix [Name only to replace Eugnathus pre-occupied by Eugnatha, Aud.]

E.sp. G. D'Erasmo, 1931, Pal. Ital. xxxii p. 33 t-f 10-11 (Somaliland).

Isopholis sp. ? Jurassic: Turkestan. Gorizdro-Kulczyca 1926, p. 191, t-f. vi.

Eug. brachilepis s.n. F. Bassani, 1896, Pal. Ital.
1 p. 199. pl. 7 figs. in d. Semin. commentatio
Costa (Espana) a. Trias: Ital.

more than one series over the whole of the splenial; preoperculum smooth and narrow; suboperculum of moderate size, about half as large as the nearly rectangular operculum, and with a short ascending process at its antero-superior angle. Ossifications in the sheath of the notochord observed only in the largest species; ossified ribs slender. Fulcra biserial, well-developed on all the fins except the pectorals, on which they are feeble. Pectoral much exceeding the pelvic fins in size, but the latter well-developed; dorsal and anal fins triangular in shape, the former arising opposite or immediately behind the pelvic fins; caudal fin forked. Scales thick, with a narrow overlapped border, an inner rib, and a feeble peg-and-socket articulation; superficial ganoine smooth on the anterior half of each scale, passing on part of the body into transverse rugæ and crenulations posteriorly; principal flank-scales rarely, and then only in part, deeper than broad, several series of ventral scales much broader than deep; postclavicular scales large; no enlarged scales on the dorsal ridge or in the region of the anus. Lateral line inconspicuous.

A description of the skeleton of *Eugnathus* will equally apply to *Heterolepidotus* (see p. 304), which differs only in minor particulars. The chondrocranium is well ossified, and the basicranial axis is straight. The basioccipital exhibits on its posterior face a deep conical fossa for the notochord; and the inferior aspect of the bone is marked by a slight longitudinal groove, though there is apparently no basicranial canal. A robust ossification is conspicuous both in the postfrontal and in the prefrontal region. Nearly the whole of the base of the skull is sheathed by a large parasphenoid, which appears to terminate in advance of the occiput and exhibits a pair of long basipterygoid processes. In front of the latter the parasphenoid bears a long, lenticular patch of minute granular teeth. The vomers are unsatisfactorily known, but a cluster of larger short and conical teeth appears to belong to them: they are certainly paired in *Heterolepidotus*. The membrane bones of the cranial roof form a continuous shield, which is nearly flat. The parietals are small and short, meeting in a remarkably wavy suture which makes them an unsymmetrical pair. These are flanked by the squamosals, which are somewhat longer and form the postero-lateral angles of the cranial roof. The frontals are very large, broad behind but attenuated in front; and the median suture between them is more or less wavy in its hinder portion. The postfrontal is exposed at the anterior end of the squamosal, and between it and the prefrontal there extends a series of about three supraorbital plates. The cheek is completely covered with thin

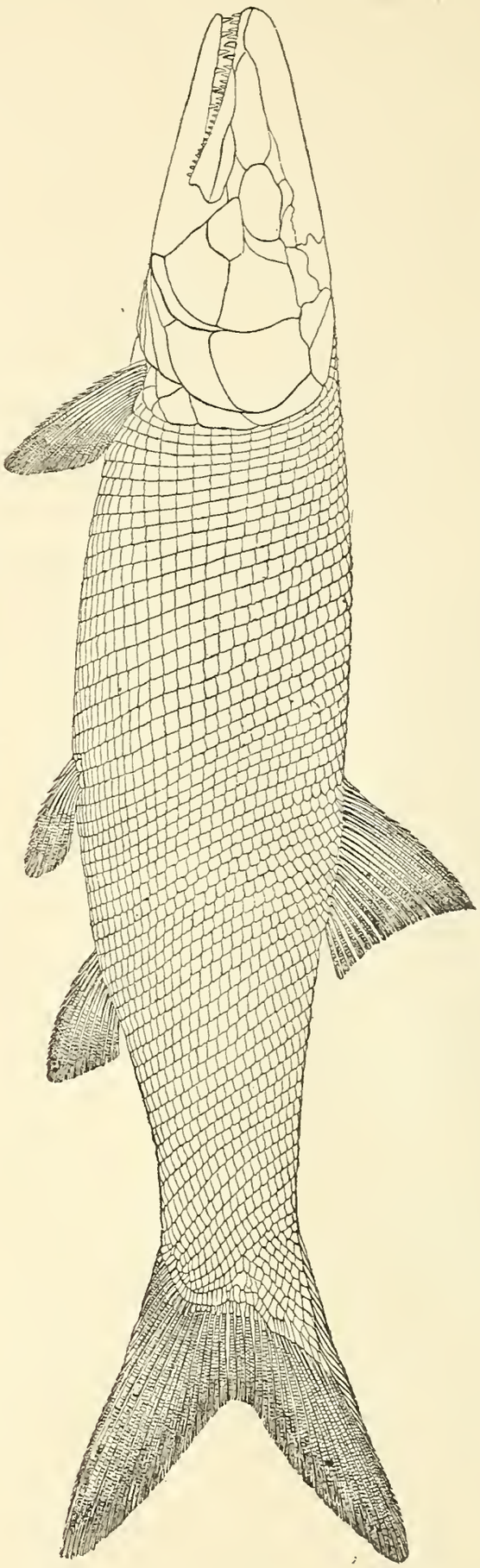


Fig. 33.

Eugnathus orthostomus; restoration.

plates. There are two very large suborbitals (or postorbitals) immediately in front of the preoperculum, and there is a circumorbital ring of small plates of irregular size. At least one large preorbital plate may also be noticed. The maxilla is comparatively robust, long and narrow, somewhat deepened behind and with a stout inwardly directed process near its anterior extremity. Its hinder margin is excavated by a sharp re-entering angle, and the oral margin is straight or slightly concave. Above the posterior half of the bone is a long narrow supramaxilla, which is pointed in front but truncated behind. The premaxilla is antero-posteriorly extended, not deepened, but with a short narrow process rising upwards near the middle of its superior border. The hyomandibular is elongated, much laterally compressed, and with a large process for the support of the operculum. Its long axis is only slightly arcuated, and its expanded lower extremity meets both the quadrate and the symplectic. The latter is an elongated triangular bone, its narrow base turned upwards in contact with the hyomandibular, its thickened apex apparently extending to the articular condyle of the quadrate. The entopterygoid is a large laminar bone covered on the oral face by minute granulations resembling those of the parasphenoid. The ectopterygoid and palatine are not certainly known. The mandible is much deepened in the coronoid region, but the limits of the coronoid bone are rarely observed; it is shown in the original of fig. 34, p. 293. The angular element is of moderate size, meeting the dentary in a wavy suture in the coronoid region. The dentary itself also rises in the front part of this elevation, but rapidly tapers and becomes very narrow at the symphysis; it bears a single series of large conical teeth. The splenial, also partly extended into the coronoid elevation, is a thin laminar bone behind, but much thickened in front, where it enters and strengthens the mandibular symphysis. Its teeth are all minute, those in its hinder portion being mere granulations. The ceratohyal is very large, deep and laterally compressed behind, but apparently depressed in front so that its inferior border exhibits a narrow flattened horizontal expansion. The triangular epihyal is small and thin; the hypohyal on each side is a still smaller, but square and much thicker bone.

The branchial arches are delicate and exhibit the channel specially characteristic of modern bony fishes. They bear a much-spaced series of large slender gill-rakers, which are straight and acutely pointed. The basibranchials are slender. The opercular apparatus is complete; the branchiostegal rays are laminar; and

there is a large gular plate covering the whole of the space between the mandibular rami in front of them.

The notochord is persistent, but there are usually some traces of hypocentra and pleurocentra, and these are often robust in the larger individuals. In the abdominal region there are slender ribs loosely articulated with short prominences on the hypocentra; and there is the series of large free neural spines, so well known in *Caturus*, extending as far as the anterior portion of the dorsal fin. In the caudal region the neural and hæmal arches are stout, and the hæmal spines at the base of the caudal fin are somewhat expanded.

A single pair of transversely extended supratemporal plates overlaps the occiput, and immediately behind is observed the exposed portion of a pair of large triangular post-temporals, which support the pectoral arch. The supraclavicle is long and narrow, and the arched clavicle is relatively very large. The latter element is contracted and thickened above, with a considerable outer lamina mesially, and tapering to a delicate point below where it meets its fellow of the opposite side. On its antero-superior angulation there are several longitudinal rugæ. The scapula, coracoids, and basals are not satisfactorily known; but it is clear that the immediate supports of the pectoral fin-rays were much like those of *Ophiopsis* (p. 167, Pl. III. fig. 3), the hindermost basal being the largest. The pelvic fin-supports are irregularly hourglass-shaped, much more expanded proximally than distally, as shown in *Caturus* (Pl. IX. fig. 3). Conspicuous biserial fulcra appear on all the fins.

Thick rhombic ganoid scales cover the whole of the trunk, and are arranged in regular oblique series except immediately at the base of the caudal fin, where the last row is directly related to covering the base of the rays. Each scale is strengthened on its inner face with a vertical median rib; and the principal flank-scales are also united by a peg-and-socket articulation. A series of four large postclavicular scales is connected with the clavicle. None of the ordinary scales, however, are enlarged either along the dorsal margin or in the region of the anus. The position of the latter close to the origin of the anal fin is indicated by coprolitic matter in no. 48006. Some of the ventral scales in the region of the pectoral fins are much subdivided.

1911. Eugnathus orthostomus, O. Jaekel, Die Wirbel-
tiere, p. 85, fig. 96 [restoration of head, etc.].
1937. Eugnathus orthostomus, T.J. Weston, p. 375, fig. 8a.

Eugnathus orthostomus, Agassiz.

[Plate IV. fig. 1 ; Pl. V. fig. 1.]

1825. *Lepidosteus? dentosus,* C. Koenig, Icon. Foss. Sect. pl. xii. fig. 140.

1842–44. *Eugnathus orthostomus,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 98, pl. lvii *a*.

1839–44. *Eugnathus speciosus,* L. Agassiz, *ibid.* p. 100, pl. lvii. [Head and scales ; Oxford Museum.]

1844. *Eugnathus scabriusculus,* L. Agassiz, *ibid.* p. 105 (name only). [Jaws, etc. ; British Museum.]

Type. Nearly complete fish ; British Museum.

The type species, attaining a length of about 0·6. Length of head with opercular apparatus equalling about one-quarter, and maximum depth of trunk about one-fifth of the total length of the fish ; minimum width of caudal pedicle equalling half the maximum depth of the trunk. Head elongated, the roof of the skull being about three times as long as its width at the occiput, and all the external bones smooth or with few small tuberculations ; hinder two-thirds of maxilla bearing comparatively small and slender elongated teeth, with stouter conical teeth in front and on the premaxilla ; supramaxilla much more than half as long as maxilla ; dentary bone with few widely spaced, large, stout teeth ; splenial teeth small ; operculum almost as broad as deep. Dorsal fin as deep as long, with about 16 rays, arising in advance of the middle point of the back ; origin of pelvic fins exactly opposite to that of the dorsal, and the relatively small anal fin, with about 9 rays, arising at the posterior termination of the latter. Scales richly ornamented in the abdominal region, smooth on the caudal pedicle ; a few anterior flank-scales slightly deeper than broad.

Form. & Loc. Lower Lias : Dorsetshire.

All the following specimens were obtained from the neighbourhood of Lyme Regis :—

P. 465. Type specimen described and figured by Agassiz, *loc. cit.* The small teeth in front of the mandible noted in the original description are evidently those of the splenial bone, and other specimens prove that the enlargement of the teeth does not take place in the middle of that bone, but at its anterior extremity. In the crushed ventral region there are remains of the squamation of a small fish, apparently swallowed. *Egerton Coll.*

P. 3639. A slightly larger fish, with more imperfect anal and caudal fins. The crushed cranium is exposed from below, and the maxilla is complete, only broken across at one point; the large teeth are conspicuous on the premaxillæ, as also on the left dentary; and below the mandible the great extent of the gular plate is displayed. There are indications of slender ribs in the abdominal region, and the fish seems to have swallowed a *Pholidophorus*. The squamation is well preserved, and the dorsal fin almost complete. *Enniskillen Coll.*

P. 3642. A smaller fish, more fractured, showing much of the abdominal squamation from the inner aspect and displaying the robust peg-and-socket articulation of the flank-scales. *Enniskillen Coll.*

38120. Fish about 0·42 in length, shown from the ventral aspect. The marginal dentition, branchiostegal apparatus, and paired fins are well shown. Both the pectoral and pelvic fins exhibit fulcra, and these on the latter are distinctly shown to be biserial. Each pelvic basipterygium seems to have been much expanded proximally, and contracted to a very narrow distal end. *Purchased*, 1864.

38119. A similar specimen with more displaced squamation and with few teeth, but showing the anal fin. The fulcra on the pectoral fins are relatively small, those on the pelvic fins and anal fin well developed and biserial. Some scales in the abdominal region exhibit the peg-and-socket articulation. *Purchased*, 1864.

47043. Equally large fish, much fractured, showing the head from the dorsal aspect, the trunk in side view, and wanting the caudal fin. *Purchased*, 1875.

P. 2027, P. 2034. Two imperfect specimens about as large as the last; one displaying several head-bones in side view, part of the paired fins with fulcra, and some well-preserved scales; the other vertically crushed, much fractured, and wanting all the fins except the caudal. *Egerton Coll.*

38735. Another imperfect specimen, showing displaced bones of head and wanting median fins. *Purchased*, 1865.

P. 3633 a. Two imperfect specimens, the first showing the robust hæmal spines at the end of the caudal pedicle, the second exhibiting the jaws and branchiostegal apparatus. *Enniskillen Coll.*

P. 3633 b. Head, pectoral fin, and anterior squamation of a large fish, exhibited from the left side and shown of the natural size in Pl. IV. fig. 1. Many of the bones are well displayed, and are indicated in the figure by the lettering. There are very few traces of a tubercular ornament, apparently confined to the supratemporal, post-temporal, and operculum, though a few isolated tubercles also occur on the cranial roof. The postclavicular scales are conspicuous, and some of the anterior flank-scales are deeper than broad. *Enniskillen Coll.*

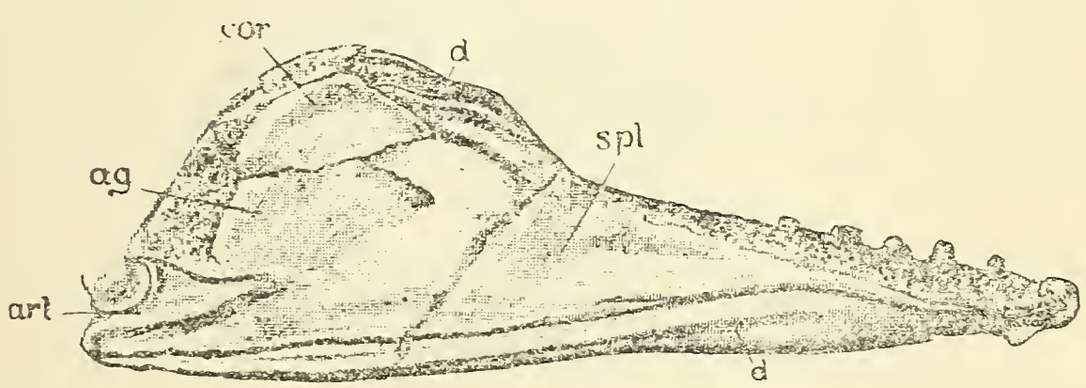
P. 3633 c, d. A small fish about 0·32 in length, very fragmentary, and another more imperfect small specimen.
Enniskillen Coll.

P. 3634 f. Small head apparently referable to young of this species, but not so much elongated as in the typical adult fishes.
Enniskillen Coll.

P. 509. Imperfect right mandibular ramus and maxilla, with remains of surrounding bones and scales; the undescribed type specimen of the so-called *Eugnathus scabriusculus*, Agassiz, *loc. cit.* The specimen is shown of the natural size in Pl. V. fig. 1. *Egerton Coll.*

P. 865. Fragment of head showing jaws, labelled *Eugnathus speciosus* by Agassiz. *Egerton Coll.*

Fig. 34.



Eugnathus orthostomus; left mandibular ramus, inner aspect. [No. P. 870.]
ag., angular; *art.*, articular; *cor.*, coronoid; *d.*, dentary; *spl.*, splenial.

P. 870. Left mandibular ramus, inner aspect, probably of this species. As shown by the accompanying illustration (fig. 34), the angular (*ag.*), articular (*art.*), coronoid (*cor.*), dentary (*d.*), and splenial elements (*spl.*) can be distinguished. *Egerton Coll.*

Eugnathus philpotæ, Agassiz.

[Plate V. fig. 2.]

1839–44. *Eugnathus philpotiæ,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 101, pl. lviii.

1839–44. *Eugnathus polyodon,* L. Agassiz, *ibid.* p. 104, pl. lviii *a.* fig. 2. [Imperfect head; Oxford Museum.]

1844. *Eugnathus opercularis,* L. Agassiz, *ibid.* p. 104. [Fish; unknown.]

1868. *Eulepidotus sauroides,* Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxiv. p. 503. [Nearly complete fish; British Museum.]

1872. *Heterolepidotus sauroides,* Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv.), no. 3, pl. iii.

1887. *Ophiopsis sauroides,* K. A. von Zittel, Handb. Palæont. vol. iii. p. 217.

1890. *Eugnathus philpotæ,* Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 79.

Type. Fish, wanting jaws; Oxford Museum.

A larger species than the type, attaining a length of about 0·7, and with a relatively deeper, dorsally-arched abdominal region. Length of head with opercular apparatus not exceeding the maximum depth of the trunk, and contained nearly five times in the total length of the fish. Head short and broad, the roof of the skull being less than twice as long as its width at the occiput, and all the external bones smooth or with few small tuberculations; maxillary teeth numerous and slender, those of the premaxilla and dentary much larger, fewer, and more robust, but attenuated to a slender, more or less curved point; splenial teeth small; operculum as broad as deep. Fins as in the type species, but the anal apparently somewhat more remote. Scales relatively larger than in the type species, usually less conspicuously ornamented, otherwise similar.

Some specimens (*e. g.* no. P. 2021) prove that in this species there are ossifications in the sheath of the notochord.

Form. & Loc. Lower Lias: Dorsetshire.

All the following specimens were obtained from the neighbourhood of Lyme Regis:—

P. 3577. A fine specimen, nearly complete, about 0·7 in length. The long slender mandibular teeth are conspicuous.

Enniskillen Coll.

P. 3576. An equally large fish, more fractured and somewhat

?1826. H. d. l. Beche Trans. Geol. Soc. (2) ii (1829) p. 27 pl. iv f. 1.

1937. Eupachydiscus philippotaei, T.S. Westphal, p. 375 pl. 8 f. 4.

deepened by distortion; noticed by Egerton, *loc. cit.* 1872, under the name of *Heterolepidotus sauroides*.
Enniskillen Coll.

P. 559. Another large fish with fractured tail and imperfect ventrally, the type specimen of *Heterolepidotus sauroides*, Egerton. *Egerton Coll.*

40350. A more imperfect large specimen displaying the maxilla and mandible with dentition, and also the paired fins with fulcra. *Purchased*, 1867.

P. 2019. Imperfect remains of head and trunk of another large fish.
Egerton Coll.

P. 3634 h, P. 3640. More imperfect remains of head and trunk of two large specimens, the first displaying upper and lower teeth. *Enniskillen Coll.*

P. 2021. Hinder portion of head and remains of anterior portion of abdominal region, displaying the pectoral fins and well-developed hypocentral ossifications in the axial skeleton.
Egerton Coll.

P. 7522. Much-fractured specimen displaying hinder half of head, remains of dorsal and pectoral fins, squamation, and some of the abdominal hypocentra. *Harford Coll.*

P. 3578. Fish about 0·56 in length, with partly displaced squamation and crushed head. The dorsal and caudal fins are especially well shown. *Enniskillen Coll.*

40349. An equally large fish, more fragmentary, crushed from above, displaying the roof of the skull and the right pectoral fin. *Purchased*, 1867.

P. 1543. Crushed head and part of abdominal squamation of a similar fish. *fig. 2 Western 1937, p. 86.* *Egerton Coll.*

P. 3629. Head of similar specimen, vertically crushed. The branchiostegal rays and the left maxilla and mandibular ramus are well shown, with the characteristic teeth.
Enniskillen Coll.

38104. Equally large head with opercular apparatus in side view. The form and proportions of the opercular bones are well shown (Pl. V. fig. 2), and part of the dentition is preserved, but the rostral region is destroyed. *Purchased*, 1864.

P. 4233. Vertically crushed head, pectoral fins, and some anterior scales, seen from above. The supratemporals are finely tuberculated. *Enniskillen Coll.*

19483. Imperfect fish about 0·47 in length, vertically crushed, displaying some of the slender neural spines and ribs of the axial skeleton, and the biserial fulcra on the dorsal fin. *Purchased*, 1845.

P. 3634 a, b, P. 3641. Two equally large imperfect specimens, and one smaller individual showing head from the infero-lateral aspect. *Enniskillen Coll.*

P. 3634 c, d. Imperfect fish about 0·43 in length, and a smaller distorted specimen. *Enniskillen Coll.*

38122. Small specimen about 0·32 in length, much crushed and imperfect. *Purchased*, 1864.

P. 2035, P. 3638 a. Two small specimens vertically crushed and shown from the ventral aspect. *Egerton & Enniskillen Colls.*

P. 3634 g. Remains of small head, pectoral fin, and scales, probably of this species. *Enniskillen Coll.*

Eugnathus minor, Agassiz.

[Plate IV. fig. 3; Plate V. fig. 3; Plate VI. fig. 1.]

1839. *Eugnathus minor*, L. Agassiz, Neues Jahrb. p. 118.
1839–44. *Eugnathus minor*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 103, pl. lviii *a*. fig. 1.

Type. Portion of head and trunk; Oxford Museum.

A species of moderate size, attaining a length of about 0·35. Length of head with opercular apparatus not much exceeding the maximum depth of the trunk, and contained somewhat less than four times in the total length of the fish. Head comparatively broad, the width of the roof of the skull at the occiput equalling about one-half of its length; external bones smooth or with few small tuberculations; maxillary teeth small, slender behind and stouter in front; premaxillary teeth larger and robust; dentary teeth stout and well-spaced, relatively smaller and more numerous than in the type species, and splenial teeth small; operculum considerably deeper than broad. Fins and squamation as in the type species.

Form. & Loc. Lower Lias: Dorsetshire.

The following specimens were all obtained from the neighbourhood of Lyme Regis :—

P. 2030. Nearly complete fish, with crushed head, shown of two-thirds the natural size in Pl. VI. fig. 1. The head is obliquely distorted, but its proportions are indicated and part of the dentition is well shown. The maxilla (*mx.*) bears small and slender teeth increasing in stoutness forwards, and the horizontally extended premaxilla (*pmx.*) shows a close series of eight or nine robust teeth; the dentary bone also exhibits its sparse series of comparatively large and stout teeth. The cheek-plates and opercular bones are crushed beyond recognition, and the squamation behind is much displaced. Portions of all the fins are shown, but only the caudal fin is well preserved. *Egerton Coll.*

P. 2031–33. Two specimens somewhat smaller, and a third fish, still smaller, wanting the caudal fin. The first specimen is nearly complete, distorted a little in the caudal region, and with good squamation; the second wants the greater part of the skull and jaws; the third displays the opercular bones and the dentition of maxilla and dentary. *Egerton Coll.*

P. 3630, P. 3636–38, P. 4234. Five specimens more or less imperfect, varying in length from 0·33 to 0·23, and all exhibiting part of the dentition. *Enniskillen Coll.*

P. 3634 e. A distorted and disturbed specimen, showing some scattered bones of the head. The hyomandibular is shown to be a laterally-compressed, expanded bone; and the left mandibular ramus (Pl. IV. fig. 3), with its elevated coronoid region, is well exposed. Some of the scales exhibit a robust peg-and-socket articulation. *Enniskillen Coll.*

38526. A small distorted fish, the trunk chiefly shown in impression. Part of the roof of the skull, the left maxillary and dentary bones are exhibited; and there is a displaced portion of vertebral column, probably of the same fish, which seems to comprise ossifications in the notochordal sheath. *Purchased*, 1864.

48006. Imperfect fish, ventral aspect, displaying branchial arches, the very small anterior ventral scales, and a coprolite at the origin of the anal fin. *Purchased*, 1877.

35055. A much-fractured small fish. *Purchased*, 1860.

P. 871. Greater part of fish, about 0·15 in length. *Egerton Coll.*

P. 3628. Imperfect head and opercular apparatus with part of the anterior squamation, shown of the natural size in Pl. V. fig. 3. The operculum (*op.*) exhibits the form characteristic of the species; the cranial roof and portions of the jaws are also well shown. *Enniskillen Coll.*

P. 864. Head and anterior portion of a typical fish. *Egerton Coll.*

P. 6062. Small head and anterior portion of trunk. *Presented by F. Harford, Esq.*, 1889.

P. 868, P. 3627, P. 3634 k. Three small specimens exhibiting the head in an imperfect state. *Egerton & Enniskillen Colls.*

P. 3631. Imperfect head with relatively large teeth, and other fragmentary remains. *Enniskillen Coll.*

P. 3634 l. Remains of head, opercular apparatus, postclavicular scales, and pectoral fin, perhaps of an unusually large individual of this species. *Enniskillen Coll.*

P. 3638 b. Fish with imperfect head, wanting jaws and caudal fin, doubtfully ascribed to this species. The scales are unusually finely ornamented. *Enniskillen Coll.*

Eugnathus serratus (Davis).

1884. *Lissolepis serratus*, J. W. Davis, Ann. Mag. Nat. Hist. [5] vol. xiii. p. 449, pl. xvi.

1890. *Eugnathus serratus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 79.

Type. Fish wanting dorsal fin; James W. Davis Collection, Chevinedge, Halifax.

A species of moderate size, apparently differing only from *Eugnathus minor* in its relatively smaller, more numerous mandibular teeth, in the comparatively deeper abdominal region and more slender caudal pedicle.

This is the type species of the so-called *Lissolepis*.

Form. & Loc. Lower Lias: Dorsetshire.

P. 2028. A somewhat elongated specimen, crushed and fractured, and probably of this species; Lyme Regis. The specimen bears the MS. name, *Eugnathus fusiformis*, in Egerton's handwriting. *Egerton Coll.*

Eugnathus altus, sp. nov.

[Plate VI. fig. 2.]

Type. Imperfect fish ; British Museum.

A species of moderate size, similar in proportions to *E. serratus*. All the marginal teeth slender and in close series, but those of the dentary much exceeding those of the maxilla in size. Scales relatively smaller than in any of the foregoing species.

Form. & Loc. Lower Lias : Dorsetshire.

P. 2029. The type specimen shown of two-thirds the natural size in Pl. VI. fig. 2 ; Lyme Regis. The bones of the head are displaced and scattered, but some are well shown. The dentary (*d.*), maxilla (*mx.*), and premaxilla (*pmx.*) exhibit long, slender teeth ; while portions of the inner bones of the mouth are covered with granular teeth. The form of the hyomandibular (*hm.*) is also well shown, and the subopercular (*s.op.*) is seen to bear an ascending process at its antero-superior angle. Behind the opercular apparatus the clavicle (*cl.*) is displayed, showing vertical ribbing on the outer face ; but only fragments of the pectoral, pelvic, dorsal, and caudal fins are preserved, while the anal fin is wanting. Some of the anterior flank-scales are deeper than broad, and the ornament does not entirely disappear until the series at the hinder end of the dorsal fin. *Egerton Coll.*

Eugnathus hastingsiæ (Agassiz).

[Plate VII. fig. 1.]

1843–44. *Pholidophorus hastingsiæ,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 284, pl. xlii *a*. fig. 1.

Type. Imperfect fish ; British Museum.

A very small species, attaining a length of about 0·1. Length of head with opercular apparatus equalling about one-quarter, and maximum depth of trunk scarcely more than one-sixth of the total length of the fish ; maximum width of caudal pedicle equalling half the maximum depth of the trunk. Head elongated, and the external bones almost or quite smooth ; mandibular teeth few and stout, maxillary teeth closely arranged and slender ; operculum very slightly broader than deep. Fins as in the type species. Scales very feebly ornamented in the anterior abdominal region, smooth and not serrated in the caudal region.

Form. & Loc. Lower Lias : Leicestershire and Warwickshire.

P. 3594. Type specimen, wanting the head and dorsal margin, and not exhibiting the "lateral line" so conspicuously as indicated in the drawing published by Agassiz; Barrow-on-Soar. *Enniskillen Coll.*

P. 887 a. Another less imperfect specimen, shown of the natural size in Pl. VII. fig. 1; locality unknown, but probably from Barrow-on-Soar. The definition of the species given above is based upon this specimen. The teeth are very imperfectly displayed. Impressions of the neural arches above the notochord are distinct, and there are also traces of ribs besides the robust hæmal arches at the base of the caudal fin. *Egerton Coll.*

P. 888. Another larger specimen about 0·1 in length; Barrow-on-Soar. The opercular and branchiostegal apparatus is especially well shown, and all the fins are preserved. *Egerton Coll.*

P. 6096. Remains of head, opercular apparatus, and pectoral arch, probably of this species; Lower Lias, Wilmcote, near Stratford-on-Avon. *Presented by the Rev. H. E. Lowe*, 1889.

Eugnathus microlepidotus, Agassiz.

1833. *Uræus microlepidotus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12.
1839. *Eugnathus microlepidotus*, L. Agassiz, Neues Jahrb. p. 118.
1844. *Eugnathus microlepidotus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 104.
1863. *Eugnathus microlepidotus*, A. Wagner, Sitzungsb. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 673.

Type. Imperfect fish; Palæontological Museum, Munich.

A species of moderate size, attaining a length of about 0·4. Length of head with opercular apparatus much exceeding the maximum depth of the trunk, and contained about four times in the total length of the fish. Head elongated and the external bones conspicuously ornamented with tubercles and delicate rugæ; teeth on the dentary bone large and very robust. Fins apparently as in the type species. Principal scales completely covered on their exposed face with a delicate striate ornament.

A fish from the Lithographic Stone of Cirin, Ain, France, not readily distinguished from this species, is named *Eugnathus prælongus* by V. Thiollière, Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii.

1906. Eugnathus microlepidotus, E. Heinecke, Geol. u. Paläont Abhandl. vol. xii. p. 183, pl. xxviii. figs. 5–7, pl. xxx. fig. 5; text-figs. 7.

1949. Eu. praelongus, P. de Saint-Seine N. Archiv. Mus. H.N. Lyon 2 p. 155 [illegible] xvi f. 13, xvii f. 15

p14. Eugnathus longiserratus, C.R. Eastman, Mem. Carnegie Inst. vol. vi. p. 410, pl. lxiv. figs. 1, 2.
1942. E. l. G. Heinberg, Palaeontogr. 97 A. p. 97. pl. viii f. 2.

(1850), p. 150, and Poiss. Foss. Bugey, pt. ii. (1873), p. 19. The type specimen is preserved in the Lyons Museum.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

49138. Plaster cast of nearly complete fish, the original in the Palæontological Museum, Munich, noticed by Wagner, *loc. cit.* p. 673; Eichstädt. *Purchased*, 1878.

P. 511, P. 3646. Remains of a large specimen in counterpart, displaying the scale-ornament and the stout mandibular teeth; Solenhofen. *Egerton & Enniskillen Colls.*

P. 3717. Imperfect head and anterior abdominal region; Solenhofen. *Enniskillen Coll.*

P. 3646 a. Scattered remains of small head and trunk, including ring-vertebræ and comparatively thick scales; Solenhofen. The sparse tuberculation is shown on some of the external bones. *Enniskillen Coll.*

Eugnathus longiserratus (Agassiz).

1843–44. *Pholidophorus longiserratus*, L. Agassiz (*ex* Münster MS.), Poiss. Foss. vol. ii. pt. i. p. 277, pl. xxxviii. fig. 2.

1863. *Pholidophorus longiserratus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 664.

1863. *Pholidophorus brevivelis*, A. Wagner, *ibid.* p. 664. [Nearly complete fish; Palæontological Museum, Munich.]

1887. *Isopholis longiserratus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 216.

1887. *Isopholis brevivelis*, K. A. von Zittel, *ibid.* p. 216.

Type. Nearly complete fish; Palæontological Museum, Munich.

A small species attaining a length of about 0·2. Length of head with opercular apparatus somewhat exceeding the maximum depth of the trunk, and equalling nearly one-quarter of the total length of the fish. Head elongated, and external bones with a rugose ornament. Fins as in the type species. Scales with relatively few, deep serrations on the hinder border.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37081, 37100, 37804. Two specimens in counterpart, and a larger crushed and distorted fish; Solenhofen. *Häberlein Coll.*

49128. Plaster cast of type specimen of so-called *Pholidophorus brevivelis*; Eichstädt. *Purchased*, 1878.

P. 1082. Four fragments, probably of this species; Solenhofen. *Egerton Coll.*

Eugnathus latimanus (Agassiz).

1838–44. *Pholidophorus latimanus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 280, pl. xliii.

1863. *Pholidophorus latimanus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 665.

1881. *Pholidophorus latimanus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 58.

1887. *Isopholis latimanus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 216.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species closely similar to *E. longiserratus*, but apparently attaining only a smaller size, and with a relatively smaller head. The flank-scales are also deeper in proportion to their length.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37098. Fish 0·1 in length, wanting the anal fin; Solenhofen. *Häberlein Coll.*

P. 1086. Slightly smaller specimen, wanting the greater part of the caudal fin; Solenhofen. *Egerton Coll.*

37093. Contorted specimen; Solenhofen. *Häberlein Coll.*

The following specimens are specifically indeterminable and may pertain either to *Eugnathus* or to *Heterolepidotus*:—

P. 3525. Fragment of head with abraded anterior portion of trunk, described as the type specimen of *Lepidotus pectinatus* by Egerton, Proc. Geol. Soc. vol. iv. (1843), p. 183, and Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv. 1852), no. 3, pl. iii.; Upper Lias, Whitby, Yorkshire. *Enniskillen Coll.*

P. 450. Abraded mandibular ramus shown of the natural size in Pl. VIII. fig. 2, regarded by Agassiz as the type specimen of an undescribed species of *Aspidorhynchus* (*Aspidorhynchus anglicus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 139, name only); Upper Lias, Whitby. *Egerton Coll.*

39143. Portion of squamation ascribed to *Lepidotus rugosus* by Agassiz, Poiss. Foss. vol. ii. pt. i. p. 246, pl. xxxiii *a*. fig. 4; Upper Lias, Whitby. *Bowerbank Coll.*

1881. *Ph. latimanus*, Vetter = *Eugnathus vetteri*, sp. nov. E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii (1906), p. 181, pl. xxx. figs. 2–4. [Nusplingen.]

P. 3525. Noticed, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii (1895), p. 35.

P. 450. Noticed loc. cit. 1895, p. 35.

39143. Noticed loc. cit. 1895, p. 35.

P.508.

Eugnathus fasciculatus, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii (1895), p. 33, pl. iii. fig. 7 (scales).

P.4468.

Eugnathus fasciculatus, ~~de? Dipt.~~ loc. cit. p. 33, pl. iii. f. 6.

P. 508. Imperfect squamation and other fragments, specifically indeterminable, but marked as the type specimen of *Eugnathus fasciculatus*, Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 105 (name only); Upper Lias, Whitby.
Egerton Coll.

P. 873, P. 4468. Small fish in counterpart, wanting the head, and labelled *Eugnathus fasciculatus* by Agassiz. The pectoral fin is relatively large, with about 15 rays; the dorsal fin arises opposite a point midway between the pectoral and anal fins; the latter is only about half as large as the dorsal. *Egerton & Enniskillen Colls.*

28855 a. Fragmentary small trunk in counterpart; Upper Lias, Cheltenham. *Purchased*, 1854.

32450. Head and greater portion of trunk of a small fish, with highly ornamented scales which are serrated even in the hinder portion of the caudal region; Upper Lias, Caen, Normandy. The mandibular teeth are only moderately robust, and the operculum is considerably deeper than broad. *Tesson Coll.*

P. 7563. Portion of abdominal region displaying some of the anterior flank-scales; Lower Lias, Lyme Regis.
Presented by Edward Charlesworth, Esq.

P. 510. Imperfect left maxilla, shown from the outer aspect of the natural size in Pl. IV. fig. 2, intended by Agassiz to be the type specimen of his undescribed species *Eugnathus tenuidens* (Poiss. Foss. vol. ii. pt. ii. 1844, p. 105); Lower Lias, Street, Somersetshire. *Egerton Coll.*

P. 517. Imperfect fish about 0·15 in total length, intended by Agassiz to be the type specimen of his undescribed species *Pholidophorus leptocephalus* (Poiss. Foss. vol. ii. pt. i. 1844, p. 288); Lower Lias, Street. The cranium is wanting, but the right opercular and facial bones are exhibited in impression. The characteristic maxilla and its dentition are distinctly observable; while the operculum is shown to be about as deep as broad. The fins are represented only by insignificant fragments, but the dorsal is proved to have been relatively large. The principal flank-scales are very delicately crimped and serrated on their hinder margin in the abdominal region,

but smooth in the caudal region. The squamation is too much disturbed both dorsally and ventrally to exhibit the precise form and proportions of the trunk. *Egerton Coll.*

P. 867. Small slab of Lias with imperfect clavicle and specifically indeterminable scales, labelled *Eugnathus ornatus* by Agassiz, and perhaps intended to be the type specimen of this undefined species (Poiss. Foss. vol. ii. pt. ii. 1844, p. 105); Lower Lias, Lyme Regis. *Egerton Coll.*

P. 866. Fragmentary remains of small head and trunk, showing ceratohyals and vertebral axis; Lower Lias, Lyme Regis. *Egerton Coll.*

P. 1048. Abraded and imperfect small head and abdominal region; Lower Lias, Watchet, Somersetshire. *Egerton Coll.*

The specific names *leptodus* and *mandibularis* were also proposed by Agassiz for forms of *Eugnathus* to which there is now no clue (Poiss. Foss. vol. ii. pt. ii. 1844, p. 105, names only), from the Lower Lias of Lyme Regis.

The so-called *Pholidophorus elongatus* (A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 664) from the Lithographic Stone of Solenhofen, is also probably a species of *Eugnathus*.

The type specimen is in the Palæontological Museum, Munich.

Genus **HETEROLEPIDOTUS,** Egerton.

[Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv. 1872), no. 2]

Syn. *Brachyichthys*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv. 1861), p. 47.
Eulepidotus, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxiv. 1868, p. 505[1].

A genus scarcely distinguishable from *Eugnathus*, but having the trunk more deeply fusiform, the marginal teeth relatively smaller, and ossified hemivertebræ present in all but the smallest species. Principal flank-scales serrated, usually not pectinated.

Heterolepidotus latus, Egerton.

1834–35. *Dapedius fimbriatus*, L. Agassiz, Poiss. Foss., Feuill. p. 9, and vol. ii. pt. i. p. 196.

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[1] Withdrawn in 1872, *loc. cit.*, Sauvage having named typical species of *Lepidotus* "*Eulepidotæ*" in 1867 (Catal. Poiss. Form. Second. Boulonnais, p. 20).

Eugnathus hermesi, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 94, pl. v. fig. 2. Semiondus hermesi, Bellotti MS. — Kemper; Lombardy. [Mus. Civ. Milan.]

Eugnathus Trottii : see p. 64. MS.

Eugnathus brunso-lavali, s.n. Cranbrook 1935 p. 6. f. 3, pl. ii. f. 5, 8 [Fish in Cretc. U. Lias France (Gard).

Eugnathus aldrigei, s.n. White Jura Z. Hertfordsh. G. Hemsberg. 1949; Palaeontogr. 97A. p. 95 H. 10 pl. viii f. 1.

Placed in Caliidae by Schlosser, Zittel Verb. 4th Edit. 1923, p. 118; see however, Stensiö, 1925, Tr. Fi. Sp. ii p. 224.

1924. *Heterolepidotus* ex. aff. *latus*. L. Rüger, Centralblatt für Min., N°23 December, p. 731 t-f. 6-7. (L. Lias; Baden).

1939. *Het. latus*, J. Brough, Trias. Fishes Besano, p. 76, ~~3~~ fs. 34-39, 42.

1959. *Het.* ? *latus*, F. Lemaire, Bull. Soc. geol. France (7) I : 327 3 ~~fs~~ pls. 20-22 L. Barbon - Sarthe.

1837–39. *Lepidotus fimbriatus*, L. Agassiz, *ibid.* p. 247, pl. xxxiii. *b* (in part). [Scales; Oxford Museum.]

1837. *Semionotus rhombifer*, L. Agassiz, *ibid.* p. 228, pl. xxvi *a*. [Imperfect fish; British Museum.]

1849. *Lepidotus fimbriatus*, W. C. Williamson, Phil. Trans. p. 444.

1849. *Semionotus rhombifer*, W. C. Williamson, *ibid.* p. 444, pl. xli. fig. 9.

1868. *Eulepidotus fimbriatus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxiv. p. 505.

1872. *Heterolepidotus latus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv.), no. 2, pl. ii.

1887. *Heterolepidotus fimbriatus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 204.

1890. *Eugnathus latus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 78.

Type. Nearly complete fish; British Museum.

A large species, attaining a length of about 0·7. Length of head with opercular apparatus not quite equalling the maximum depth of the trunk and occupying about one-quarter of the total length of the fish; the depth of the caudal pedicle contained two-and-a-half times in the maximum depth. Cranium, facial bones, opercular bones, and the well-developed postclavicular scales ornamented with coarse and sparse tuberculations; operculum about two-thirds as broad as deep, tapering above, and its maximum breadth equalling nearly one-third the length of the cranium; marginal teeth robust and acuminate, and the teeth on the splenial bone relatively large anteriorly. Dorsal fin as long as deep, much larger than the anal fin, and arising opposite the origin of the pelvic pair. Principal scales of the anterior series on the flank slightly deeper than broad, and marked with fine ridges terminating in the serrations of the posterior border; most of the flank scales and ventral scales as far as the origin of the dorsal and pelvic fins serrated, the others smooth.

Though not clearly indicated by Egerton, this may be regarded as the type species of the genus *Heterolepidotus*.

Form. & Loc. Lower Lias: Dorsetshire. ?L. Bark. Hauer

All the following specimens were obtained from the neighbourhood of Lyme Regis:—

38118. The type specimen figured and described by Egerton, *loc. cit.* 1872. *Purchased*, 1864.

P. 2008. Large head with anterior abdominal squamation, displaying the opercular apparatus and post-clavicular plates, noticed by Egerton, *ibid.* p. 3. *Egerton Coll.*

P. 2020. Posterior abdominal and caudal region of an equally large individual, the scales somewhat scattered dorsally and ventrally, and the fins imperfect. *Egerton Coll.*

P. 7564. Crushed specimen as large as the type, with scattered head-bones. Several of the elements are displayed, notably the hyomandibular and symplectic of both sides. The hyomandibular is relatively broad, expanded below, and not much constricted mesially; the symplectic is elongated, triangular in form, the apex being inferior and much thickened. *History unknown.*

P. 3579. A slightly smaller specimen, also with displaced head-bones and exhibiting some of the incomplete anterior vertebral rings. The base of the skull is imperfectly shown, and the left quadrato-pterygopalatine arch is exposed from the inner side. On the parasphenoid and the oral face of the pterygoids, as also on the hinder part of the splenial, the dentition is reduced to a fine granulation; but at the antero-inferior border of the ectopterygoid, either on that bone itself or on the palatine, the teeth are of moderate size and arranged in a dense cluster.
Enniskillen Coll.

P. 6395. Hinder portion of head and greater part of the squamation of a fish as large as the type, in indurated Lias. The postorbital and opercular bones are shown, and the ornament of the anterior scales is conspicuous.
Beckles Coll.

P. 3579 a. Remains of the trunk of a similar fish, showing the axial skeleton. The hypocentra in the abdominal region are broad and robust, flattened below, each with a pair of lateral processes bearing nearly straight slender ribs. The neural and hæmal arches in the caudal region are robust, and appear to be anchylosed with their respective pleurocentra and hypocentra. *Enniskillen Coll.*

P. 2009. Well-preserved smaller fish, wanting the region behind the dorsal fin. The supratemporal and post-temporal plates are shown behind the cranium and above the operculum, ornamented with tuberculations; the robust maxilla is smooth. The perforations of the scales in the lateral line are distinguishable, though inconspicuous vertical slits;

and there are indications of a similar series of perforated scales on the dorsal portion of the flank, extending as far backwards as the dorsal fin. One of the pelvic basal bones is exposed. *Egerton Coll.*

P. 6423. Distorted and partly imperfect specimen about 0·5 in length. The teeth of the dentary bone are very closely arranged. *Beckles Coll.*

P. 1538. Imperfect remains of head and greater portion of trunk of a similar fish. The biserial fulcra are well shown on the right pelvic fin. *Egerton Coll.*

P. 2011. Trunk with median fins. *Egerton Coll.*

P. 2010. Small specimen about 0·36 in length, The head is much crushed, and parts of the fins are wanting. *Egerton Coll.*

P. 1542. Remains of small specimen originally about 0·3 in length. The head-bones are much displaced, so that several internal elements are shown. The paired fins are preserved, and the greater part of the flank-squamation is exposed from within. *Egerton Coll.*

P. 3620. The type specimen of the so-called *Semionotus rhombifer* described by Agassiz, *loc. cit.*, being a fish somewhat smaller than the preceding and almost certainly the young of *Heterolepidotus latus*. The comparative smoothness of the head-bones and post-clavicular plates is apparently due to imperfect preservation. *Enniskillen Coll.*

P. 1538 b. Middle portion of trunk of a similar fish. *Egerton Coll.*

P. 1538 a. Caudal region of another small specimen. *Egerton Coll.*

Heterolepidotus serrulatus (Agassiz).

1843–44. *Lepidotus serrulatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 305, pl. xxxi.

1868. *Eulepidotus serrulatus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxiv. p. 505.

1872. *Heterolepidotus serrulatus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv.), no. 2, p. 2.

1890. *Eugnathus serrulatus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 79.

Type. Fish wanting caudal extremity ; British Museum.

A species nearly equalling *H. latus* in size, but differing in its relatively larger and smoother scales, and in the robustness of the

caudal pedicle, the depth of which equals at least half the maximum depth of the trunk.

Form. & Loc. Lower Lias : Leicestershire.

The following specimens are preserved in nodules from Barrow-on-Soar :—

P. 3580. The type specimen, in counterpart. The figure and description of the operculum are misleading, this bone attaining its maximum width inferiorly and tapering above, as proved by the next specimen. *Enniskillen Coll.*

P. 2007, P. 3580 a. Hinder part of head and the abdominal region of a large specimen in counterpart. The operculum is well shown, and the pectoral fin nearly complete.
Egerton & Enniskillen Colls.

P. 2007 a. Specimen much like the type, but wanting the anterior half of the head. The fulcra of the dorsal fin are displayed, and appear to be relatively larger than in *H. latus*.
Egerton Coll.

P. 7565. Trunk wanting head, and the squamation only preserved in impression. Fulcra are conspicuous on the anterior margin of the dorsal and pelvic fins ; and the greater part of the caudal fin is shown.

19488. Posterior abdominal and caudal region of a typical specimen, showing the greater part of the dorsal, caudal, and pelvic fins. The last-mentioned fins seem to arise just in advance of the dorsal, though there may be a displacement. There is evidence of robust vertebral elements.
Presented by the Earl of Aylesford, 1845.

19488 a. Fragment of trunk, showing pleurocentrum and hypocentrum in transverse section.
Presented by the Earl of Aylesford, 1845.

Heterolepidotus typicus (Winkler).

186[illegible] *Brachyichthys typicus*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. ~~xiv.~~), p. 53, fig. 9.

Type. Imperfect fish ; British Museum.

The type species of the so-called genus *Brachyichthys*, attaining a length of about 0·5. Length of head with opercular apparatus about equalling the maximum depth of the trunk, and contained four times in the total length of the fish. Operculum nearly as

broad as deep, and its maximum breadth exceeding one-third the length of the cranium; maxillary teeth very slender, those of the premaxilla and dentary much stouter and closely arranged. Principal flank-scales about as deep as broad; all the scales of the abdominal region very finely serrated, and many also equally finely pectinated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

43003. The type specimen, in counterpart; Solenhofen. Winkler's original description and figure are very inadequate and in part incorrect. Some further details may therefore be given, illustrated by the accompaning outline-sketch (fig. 35). The cranial roof is displaced forwards, exhibiting the thick parietals (*pa.*) and frontals (*fr.*), with the

Fig. 35.

Heterolepidotus typicus; head-bones of type specimen, less than one half natural size.

br., branchiostegal rays; *c.h.*, ceratohyal; *c.o.*, circumorbitals; *ep.h.*, epihyal; *fr.*, frontal; *hm.*, hyomandibular; *i.op.*, interoperculum; *md.*, mandible; *mx.*, maxilla; *op.*, operculum; *p.cl.*, postclavicle; *p.op.*, preoperculum; *pa.*, parietal; *pas.*, parasphenoid; *pmx.*, premaxilla; *s.mx.*, supramaxilla; *s.o.*, suborbitals; *s.op.*, suboperculum; *sq.*, squamosal; *st.*, supratemporal; *sym.*, symplectic; *v.*, vomer.

squamosals (*sq.*), from the inner aspect; while the base of the skull occurs still further forwards, apparently comprising the long and narrow parasphenoid (*pas.*) with the pair of vomerine bones (*v.*) in front. The two premaxillæ

(*pmx.*) are preserved, one at the rostral end of the cranial roof, the other just to the right of the right frontal; each with an extended oral margin and exhibiting a broad ascending process at the middle of its upper edge. The left maxilla (*mx.*) occurs in position, much deepened behind and bearing very slender teeth; above it is a relatively large supramaxilla (*s.mx.*). The right mandibular ramus (*md.*), imperfectly preserved and wanting its hinder end, is displaced beneath the head, and shows traces of small, stout conical teeth. The hyomandibular (*hm.*) is partly exposed in position, but the remainder of the suspensorium is very fragmentary, the metapterygoid only being displayed on the counterpart, and two isolated bones (*sym.*) being perhaps the symplectics; the large posterior suborbitals (*s.o.*) are obscurely indicated, and there are remains also of a smaller circumorbital ring (*c.o.*). The epihyal (*ep.h.*) and ceratohyal (*c.h.*) elements are shown, the former triangular and equilateral, the latter much contracted in front. All the opercular bones of the right side are shown from the inner aspect, the operculum (*op.*) being about as broad as deep with truncated postero-superior angle, the suboperculum (*s.op.*) with a large anterior ascending process, the interoperculum (*i.op.*) elongate-triangular, and the preoperculum (*p.op.*) narrow and arched. There are branchiostegal rays below (*br.*). Nothing can be ascertained as to the ornamentation of the external bones. The right supratemporal (*st.*) is exposed from the inner aspect, and there are traces of the enlarged postclavicular scales (*p.cl.*). One of the clavicles and both the pelvic fin-supports are displaced beneath the trunk; and, as shown by Winkler's figure, both the fins and squamation are much disturbed. The anterior margin of the dorsal fin displays conspicuous fulcra, as also does that of the lower lobe of the caudal fin, but it is not clear whether they are uniserial; one of these elements displayed below the caudal fin is distinctly so, but it may have been basal. The scales are not so much deepened on the flank as is suggested by Winkler's figure, and a large group of the much narrowed ventral scales is displaced beneath the head. All are thick, and whenever well displayed in the abdominal region they exhibit delicate serrations on the posterior margin; many are also finely pectinated. *Van Breda Coll.*

1864. Notagogus incertus O.G. Costa Ofth. Isl. inc.
Napoli (2) 1 p. 230 pl. iii f. 2.
— Semiomus auritulus ibid p. 251.
1896. Phol. cephalus. F. Bassani Pal. Ital. 1 p. 202
pls. figs

Heterolepidotus striatus (Agassiz).

[Plate VIII. fig. 3.]

1837–44. *Semionotus striatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 231, pl. xxvii *a*. figs. 6, 7.

Type. Fish wanting head and tail; British Museum.

A small imperfectly known species of robust proportions. Head and opercular bones ornamented with closely arranged coarse rugæ. Scales remarkably smooth, those on the anterior part of the body with few serrations.

Form. & Loc. Upper Trias: Tyrol.

P. 3621. The type specimen, described and figured by Agassiz, *loc. cit.*; Seefeld. The original drawing of the scales is very inaccurate, and a new figure is thus given in Pl. VIII. fig. 3. The narrow ventral scales are well shown, and quite distinct in form from those of the specimens described by Kner as referable to this species (see p. 316). The position of the pelvic fins is not indicated, but they would probably arise immediately in advance of the dorsal fin.
Enniskillen Coll.

P. 3621 a. A more imperfect specimen, apparently of this species; Seefeld. *Enniskillen Coll.*

Heterolepidotus cephalus (Kner).

1866. *Pholidophorus cephalus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. p. 325, pl. iv. fig. 2.

1889. *Pholidophorus cephalus*, W. Deecke, Palæontogr. vol. xxxv. p. 135, pl. vii. fig. 4.

1892. *Pholidophorus cephalus*, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, pp. 8, 23.

Type. Nearly complete fish.

A very small species. Length of head with opercular apparatus equalling the maximum depth of the trunk, and contained about three-and-a-half times in the total length of the fish. Opercular apparatus [probably also head] ornamented with closely arranged, coarse rugæ; operculum much deeper than broad. Dorsal and anal fins deeper than long, and the pelvic fins arising in advance of the origin of the former. Anterior scales coarsely serrated.

Form. & Loc. Upper Trias: Tyrol, Lombardy, and Salerno.

21383. Specimen agreeing almost precisely with the figure given by Kner; Seefeld. *Purchased*, 1847.

Heterolepidotus pectoralis (Bellotti).

1857. *Lepidotus pectoralis*, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia, p. 420.

1889. *Heterolepidotus pectoralis*, W. Deecke, Palæontogr. vol. xxxv. p. 114, pl. vi. fig. 8, pl. vii. fig. 10.

Type. Imperfect fish; Milan Museum.

A species attaining a length of about 0·16. Length of head with opercular apparatus exceeding the maximum depth of the trunk and occupying one-third of the total length of the fish; width of caudal pedicle contained about two-and-a-quarter times in the maximum depth of the trunk. External bones conspicuously ornamented with granulations, which are sometimes fused into rugæ; scales smooth, those of the anterior part of the trunk finely serrated; principal flank-scales about as deep as broad. (*Deecke.*)

Form. & Loc. Upper Trias: Perledo, Como.

Not represented in the Collection.

Heterolepidotus serratus (Bellotti).

1857. *Lepidotus serratus*, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia, p. 419.

1889. *Heterolepidotus serratus*, W. Deecke, Palæontogr. vol. xxxv. p. 116, pl. vi. fig. 2.

Type. Nearly complete fish; Milan Museum.

A species closely related to the preceding but somewhat more elongated, and the ornament of the external bones entirely tubercular, not rugose. Head with opercular apparatus occupying somewhat more than one-quarter of the total length of the fish; width of caudal pedicle contained about two-and-a-half times in the maximum depth of the trunk. (*Deecke.*)

Form. & Loc. Upper Trias: Perledo, Como.

Not represented in the Collection.

Heterolepidotus (?) radiato-punctatus (Agassiz).

1844. *Pholidophorus radiato-punctatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 287.

1844. *Pholidophorus maximus*, L. Agassiz, *ibid.* p. 287.

Type. Remains of head and trunk; British Museum.

A large species characterized by comparatively robust scales, which are not much deeper than broad on the flank, and are all ornamented with small tubercles of ganoine, usually more or less elongated and closely arranged in lines radiating from the anterior

1910. *Heterolepidotus pectoralis*, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 100, pl. v. f. 4; pl. vi. f. 1; pl. vii. f. 1.

1910. *Heterolepidotus serratus*, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 103, pl. vi. fig. 3.

border or from the antero-superior angle. The external bones and some of the fin-rays with a similarly fine and close tubercular ornament.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 2060. Type specimen, labelled by Agassiz and Egerton, comprising the imperfect head and scattered remains of the anterior portion of the trunk; Solenhofen. Part of the highly ornamented cranial roof is shown in impression, while the imperfect facial and opercular bones of the right side are exposed from within. The two left lower suborbitals are also shown from within where displaced above the head; and neither on these nor on those of the opposite side can the course of the sensory canal be traced. The outlines of the mandible and maxilla are not clear, but a displaced premaxilla exhibits a broad ascending process at one end, the height of this equalling the length of the dentigerous border of the bone. One imperfect element, which seems to be maxilla, has a slightly concave oral margin, with very small, closely-arranged teeth. The left operculum, though imperfect, is shown to have been deeper than broad; while the suture between this and the suboperculum is evidently oblique. A few very slender bones, which seem to be short ribs, are scattered among the remains of the trunk, but there are no traces of vertebræ. Numerous stout fin-rays occur, and two apparently from the front of the pectoral fin are covered with the tubercular ornament, while some others exhibit the same ornament on one border. The pelvic bones are shown to be no broader distally than proximally, a wing of bone extending inwards on each side from the proximal two-thirds of the normal triangular element. The scales are remarkably scattered and shown in all positions, displaying the stout inner rib and peg-and-socket articulation; but narrowed scales are few. Among the remains are the jaws of two small Pycnodonts, perhaps the relics of food.

Egerton Coll.

P. 3583. Imperfect caudal region with caudal fin, possibly of the same individual as the preceding, labelled "*Caturus maximus* or new?" by Agassiz. All the scales are ornamented, and at the base of the upper caudal lobe one ridge-scale is

enlarged. As the series are traced backwards the peg-and-socket articulation gradually disappears, while the inner rib widens and is finally indistinguishable.

Enniskillen Coll.

The following species have also been imperfectly defined, but do not appear to be represented in the Collection :—

Heterolepidotus angulati, W. Deecke, Mittheil. Comm. geol. Landes-Untersuch. Elsass-Lothr. vol. i. (1888), p. 207.—Lower Lias; Buchsweiler, Alsace. [Nearly complete trunk with hinder portion of head; Geological Survey Museum, Strassburg.]

Heterolepidotus (?) *leptocephalus*: *Semionotus leptocephalus*, L. Agassiz, Neues Jahrb. 1832, p. 145, and Poiss. Foss. vol. ii. pt. i. pp. 8, 222 (1833–44), pl. xxvi. fig. 1; F. A. Quenstedt, Flözgeb. Württemb. (1843), p. 243; O. Fraas, Württ. Jahresh. 1861, p. 83.—Upper Lias; Boll, Würtemberg. [Nearly complete fish; unknown.]

Heterolepidotus minor, J. W. Davis, Proc. Yorksh. Geol. & Polyt. Soc. n. s. vol. viii. (1883), p. 403, pl. xxii.—Lower Lias; Lyme Regis. [Fish too imperfect for specific definition; J. W. Davis Collection, Halifax.]

A fish closely resembling *Heterolepidotus* but differing in not having the tail forked, is known from the Lower Oolite of Brora, Sutherland. It is believed to have been obtained from the carbonaceous shale underlying the main seam of lignite in Strath Brora, and the original specimens are now in the Duke of Sutherland's Museum at Dunrobin Castle. The fish has been described under the name of *Semionotus joassi* (A. S. Woodward, Ann. Mag. Nat. Hist. [5] vol. xx. 1887, p. 179, pl. viii.), but its generic position must still be regarded as undetermined (W. Deecke, Palæontogr. vol. xxxv. p. 103). The detached maxilla ascribed to it (*loc. cit.* pl. viii. fig. 3) is probably named erroneously, and seems to belong to a Palæoniscid.

A generically indeterminable portion of squamation which may belong either to the Palæoniscidæ or to a fish resembling *Eugnathus* and *Heterolepidotus* is described as follows :—

Crenilepis sandbergeri, W. Dames, Palæont. Abhandl. vol. iv. (1888), p. 170, pl. xv. fig. 3.—Muschelkalk; Krainberg, near Würzburg. [Abdominal flank-squamation; University of Würzburg.]

Non Reis 1887. = Crenilepoides Stensiö 1929 Acta Univ. Lateranensis 20 p 27.

G. Conroy, 1929, Ann. Teleost. XVII. p. 103, pl. xii. f. 29-30. C. S. Goodrich 1937? p. 358-24-98.

Heterolepidotus[?] *bellottii*, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 111, pl. vi. fig. 4. — Kuper; Perledo, Como. [Mus. Civ. Milan.]

Heterolepidotus egidii ramantii, G. De Alessandri, loc. cit. 1910, p. 105; pl. vi. fig. 2. — Ibid. [R. Techn. Inst. Bergamo.]

Heterolepidotus taramellii, G. De Alessandri, loc. cit. 1910, p. 109, pl. vii. fig. 3. — Ibid. [Mus. Civ. Milan.]

Heterol. brevis & *H. gibbus*: see p. 64. MS., & 62, MS.

H. merzbacheri.

H. parvulus, K. G. Krambeger, 1905, Beitr. Pal. Österr.-Ungarns, t.f. 13. (iv) XVIII. p. 214, pl. xx, fig. 2. U. Trias; Hallein. [Fish. Geol. Samml. Bergakad. Leoben].

(*Het. ornatus*) rec. fra Varenna, C. Marchesini 1942. Natura, Milano 43 1, 2, p 2.

Crenilepis sandbergeri, E. Stolley, Palaeontogr. vol. lxiii (1920), p. 43. Muschelk. T. Ørrig 1951 tf. 6 B-D. J. Bataller Rutllan 1954 p. 98, (Perlesdell). pl. ii f. 2. 5. Trias. Spain

Crenilepis bassanii, E. Stolley, loc. cit. 1920, p. 44.
See *Colobodus bassanii*, p. 76 MS.

Conosaurus, q.v. IV. p. 612.

1910. Allolepidotus rüppelli, G. De Alessandri; Mem. Soc. Ital. Sci. Nat. vol. vii. p. 118, pl. viii. fig. 3, 4.

1910. Allolepidotus nothosomoides, G. De Alessandri; Mem. Soc. Ital. Sci. Nat. vol. vii. p. 116, pl. viii. fig. 7.

Genus **ALLOLEPIDOTUS,** Deecke.

[Palæontographica, vol. xxxv. 1889, p. 114.]

Body robust and fusiform, and the atrophied upper caudal lobe conspicuous. External head- and opercular bones delicate, more or less ornamented with rugæ and tuberculations; snout obtusely pointed [maxilla straight?]. Ossifications in the notochordal sheath absent or very feeble. Fulcra biserial, relatively large. Pelvic fins small; dorsal and anal fins triangular in shape, the former arising opposite or immediately behind the pelvic fins; caudal fin moderately forked. Scales thick, mostly smooth, sometimes with serrations of the posterior border; principal flank-scales in part deeper than broad, and none of the ventral scales much broader than deep; no enlarged series of dorsal ridge-scales. Lateral line inconspicuous.

Allolepidotus rueppelli (Bellotti).

1857. *Pholidophorus ruppelii*, C. Bellotti, in A. Stoppani, Geol. e Paleont. Lombardia, p. 428.

1889. *Allolepidotus rüppelli*, W. Deecke, Palæontogr. vol. xxxv. p. 117, pl. vi. fig. 5.

Type. Plaster cast of imperfect fish; Milan Museum.

The type species, of small size, attaining a length of about 0·1. Length of head with opercular apparatus much less than the maximum depth of the trunk, and contained more than four times in the total length. External bones nearly smooth. Dorsal and anal fins deeper than long, the former larger than the latter and arising behind the pelvic fins. Some of the principal scales of the anterior series on the flank nearly twice as deep as broad, and those of other series also more or less deepened; most of the scales of the abdominal region conspicuously serrated.

Form. & Loc. Upper Trias: North Italy.

The only known examples of this species were obtained from the black shales of Perledo, on the shore of the Lake of Como, between Varenna and Regoledo. There are no specimens in the Collection.

Allolepidotus nothosomoides, Deecke.

1889. *Allolepidotus nothosomoides*, W. Deecke, Palæontogr. vol. xxxv. p. 118, pl. vi. fig. 9.

Type. Nearly complete fish.

A more robust and somewhat larger species than the type. Length of head with opercular apparatus nearly equalling the maximum depth of the trunk and contained less than four times in

the total length of the fish. External head- and opercular bones and postclavicular scales ornamented with conspicuous coarse rugæ and tuberculations. Some of the principal scales of the anterior series on the flank nearly twice as deep as broad, and those of other series also more or less deepened; most of the scales of the abdominal region conspicuously serrated, some of those of the caudal region with a few widely-separated posterior denticles.

Form. & Loc. Upper Trias: North Italy.

P. 1548. Fish wanting head and having part of the ventral squamation displaced; Perledo, Lake of Como. *Egerton Coll.*

Allolepidotus dorsalis (Kner).

(?) 1833–44. *Pholidophorus dorsalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 9, 287 (inadequately defined).

1866. *Pholidophorus dorsalis*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. p. 324, pl. vi. fig. 1.

1866. *Semionotus striatus*, R. Kner (*errore*), *ibid.* p. 322, pl. v. fig. 1.

1867. *Semionotus striatus*, R. Kner (*errore*), *loc. cit.* vol. lvi. pt. i. p. 898, pl. i. fig. 1.

1867. *Pholidophorus dorsalis*, R. Kner, *ibid.* p. 903, pl. ii. fig. 2.

Type. Imperfect trunk.

A robust species, attaining a length of about 0·14. Length of head with opercular apparatus nearly equalling the maximum depth of the trunk and contained less than four times in the total length of the fish. External head- and opercular bones feebly ornamented with coarse rugæ and tuberculations. None of the scales much deeper than broad; few of those of the abdominal region serrated, nearly all non-serrated and smooth.

Form. & Loc. Upper Trias: Tyrol.

21380. Fish wanting head and extremity of caudal fin, but with well-preserved squamation; Seefeld. *Purchased*, 1847.

P. 1544. A more imperfectly preserved specimen, showing the caudal fin; Seefeld. *Egerton Coll.*

16655. A smaller imperfect fish, with some well-preserved scales; Seefeld. *Purchased.*

PTYCHOLEPIDE Brough 1935, p. 54.

Genus **PTYCHOLEPIS,** Agassiz.

[Neues Jahrb. 1832, p. 142.]

Trunk elegantly fusiform. Snout acutely pointed and prominent; external head-bones and opercular bones ornamented with prominent ridges of ganoine; marginal teeth comparatively small and stout,

1905. Heterolepidotus dorsalis, K. G.-Kramberger. Beitr. Pal. Österr.-Ungarns, p. 212, pl. xix. f. 2-3, pl. xx. f. 1.

1923. Plesiolepidotus dorsalis, n.g. Schlosser in Zittel Grundz. d. Pal. 4th Ed. p. 109.

1926. Heterolepidotus dorsalis, W. Deecke, Fossilium Catalogus, I: Animalia pars. 33 Pisces triadici p. 187. [Full Synonomy]

1927. Plesiolepidotus dorsalis, K. Leuchs, Centralbl. f. Min. Abt. B. p. 539. t. f.

Allolepidotus (Vogelius) triadicus, K. von Fritsch, Muschelkalk; Förderstedt. [Halle Museum.]

Allolepidotus vogelii, K. von Fritsch, Abh. naturf. Ges. Halle, Bd. 24 (1906), pl. xi, figs. 2, 3. = Eosemionotus vogelii, E. Stolley, Paleontogr. vol. lxiii (1920), p. 68, pl. x, figs. 3, 4. — Middle Muschelkalk; Förderstedt, near Staasfurt. [Nearly complete fish; Univ. Halle.] Type of Eosemionotus, Stolley, 1920, p. 73.

Ancestry of Ptycholepis, see

Aldinger 1937°, p. 287 6. Brough 1939, p. 57

1959. P. L. S. Wang, Bull. Soc. géol. France (7) 1: 916, 6 ftg. pls. 39-41.

1952. P. b. B. Brough Ist Symp. Irish p. 23 pls 42, 43.

1937° Ptych. bollensis H. Aldinger°, p. 288, ff. 85c, 86a, 88b.

1935° Ptycholepis bollensis W. Gross°, ff. 27-29, pl. viii. f. 2. (minutiae).

1918. Ptycholepis bollensis, E. Hennig, Jahrh. Ver. f. vaterl. Naturk. jahrg. 74, p.

1895. Ptycholepis bollensis, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol xiii. p. 36, pl. V.

1896. Ptycholepis bollensis, H. Scupin, Archiv f. Naturgesch. vol. i. p. 169, pl. x. f. 6 [structure of scale].

arranged in close series; preoperculum almost or completely covered by the cheek-plates; operculum quadrangular, broader above than below; suboperculum large, trapezoidal, deeper behind than in front, and without an ascending process at its antero-superior angle; branchiostegal rays few and broad, and a very large gular plate present, these being comparatively smooth. [Annular ossifications in the sheath of the notochord known only at the base of the tail in one specimen.] Fulcra biserial, conspicuous on all the fins except the dorsal; fin-rays more or less ornamented with ridges of ganoine. Pectoral much exceeding the pelvic fins in size, but the latter well-developed; dorsal and anal fins triangular in shape, the former opposed to the pelvic pair, the latter small and remote; caudal fin deeply forked. Scales thick and deeply overlapping, destitute of an inner rib, but those of the flank with a peg-and-socket articulation; the external layer of ganoine marked with deep longitudinal grooves; all the scales much longer than deep, but especially elongated in the ventral region; no enlarged series of ridge-scales, but some enlarged on the inner side of the pectoral and pelvic fins, three large scales surrounding the anus in advance of the anal fin, and some large postclaviculars conspicuous. Lateral line obscurely marked, opening on the scales by widely-separated vertical slits.

The character of the external ornament renders it difficult to observe the sutures between the head-bones in *Ptycholepis*; and the dense squamation obscures the endoskeleton of the trunk in all known specimens. The inner bones of the head and the inner dentition also remain unknown.

Ptycholepis bollensis, Agassiz.

1832. *Ptycholepis bollensis*, L. Agassiz, Neues Jahrb. p. 142 (name only).

1833–44. *Ptycholepis bollensis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 11, pt. ii. p. 108, pl. lviii. *b*.

1849. *Ptycholepis bollensis*, W. C. Williamson, Phil. Trans. 1849, p. 444.

1852. *Ptycholepis bollensis*, F. A. Quenstedt, Handb. Petrefakt. p. 203, pl. xv. fig. 5.

1858. *Ptycholepis bollensis*, F. A. Quenstedt, Der Jura, p. 231, pl. xxx. figs. 1–7, pl. xxxi. fig. 8.

1865. *Ptycholepis bollensis*, G. Cotteau, Bull. Soc. Sci. Yonne, vol. xix. pt. ii. p. 337.

1875. *Ptycholepis barrati*, H. E. Sauvage, Bibl. École Hautes Études, vol. xiv. no. 1, p. 8, pl. ii. fig. 2. [Distorted fish.]

1891. *Ptycholepis barrati*, H. E. Sauvage, Bull. Soc. Sci. Yonne, vol. xlv. pt. ii. p. 33, pl. i.

Type. Imperfectly preserved fish; British Museum.

The type species, attaining a length of about 0·35. Length of head with opercular apparatus equalling the maximum depth of the trunk and nearly one-quarter of the total length of the fish. The ridged ornament of the head coarse, very rarely mingled with few tubercles, and covering all the external bones except the gular plate and branchiostegal rays, which are nearly smooth; the supra-clavicle also ornamented with finer transverse ridges. Most of the ridges on the cranium, cheeks, and opercular bones longitudinal; the ridges on the upper portion of the dentary and hinder half of maxilla oblique. The stouter fin-rays ornamented with few fine longitudinal ridges of ganoine; pelvic fins arising midway between the pectorals and the caudal; dorsal fin with slightly more than 20 rays, arising well in advance of the pelvic pair. Scales marked with from one to four or five delicate, irregular, longitudinal furrows, sometimes discontinuous, sometimes branching, rarely reaching the hinder border except on the middle of the abdominal flank, and producing an ornament of large, incomplete, rounded ridges; the hinder border deeply and coarsely denticulated.

Form. & Loc. Upper Lias: Yorkshire, Würtemberg, and Yonne, France.

P. 3688. A much crushed and distorted fish described and figured by Agassiz, *op. cit.* 1844, to be regarded as the type specimen; Whitby, Yorkshire. One of the pelvic fins is mistaken in the original description for the anal; and the obscure caudal extremity, with traces of the caudal fin, is very inaccurately drawn. The appearance of teeth in the mandible is deceptive. *Enniskillen Coll.*

P. 858–a. Two imperfect specimens displaying some of the head-bones and the greater part of the squamation; Whitby. The first specimen exhibits the gaping mouth, but no teeth; and portions of all the fins except the anal are preserved. The second specimen is more imperfect, but shows remains of the smooth branchiostegals and gular plate. *Egerton Coll.*

P. 3691. Remains of the hinder portion of the head and the imperfectly preserved trunk of a large fish, labelled by Agassiz; Whitby. *Enniskillen Coll.*

P. 5222. Imperfect head and ventral aspect of the abdominal region of a fish preserved in a nodule; Whitby. The bases of a single regular series of small teeth are exhibited on the

P.3688. Des? Lor. cit. 1895, p. 37.

P.858. Des? & fig? Lor. cit. 1895, p. 38, pl. V. figs. 1, 1a, 1b.
P.858a. Head & anterior scales des? & fig? Lor. cit p. 39, pl. V. fig. 2.

P.3691a. Right mandibular ramus fig? Lor. cit. 1895, pl V. fig. 4.

P.5222. Des? & fig? Lor. cit. 1895, p. 39, pl. V. fig. 3.

35580. Dorsal fin noticed loc. cit. 1895, p. 40.
35581. Head noticed loc. cit. 1895, p. 39.

edge of the maxilla; and there are impressions of a ceratohyal and the large gular plate between the rami of the mandible. Two or three enlarged scales in the region between the pelvic fins are also imperfectly preserved.

Presented by Sir Richard Owen, K.C.B., 1878.

35580–82. Part of the abdominal region with dorsal fin, another specimen showing part of the head and abdominal region, and an imperfect detached caudal fin; Whitby. The number of rays in the dorsal fin is difficult to ascertain, but there appear to be slightly more than 20. The form of the suboperculum is well shown in the second specimen.

Purchased, 1859.

20579. A large fish much broken and partly deepened by distortion; Boll, Würtemberg. The maxilla displays its obliquely ridged ornament; and a few of the abdominal scales exposed from within show the peg-and-socket articulation.

Purchased, 1846.

36015. Fine large specimen wanting the dorsal and anal fins and in part much fractured; Ohmden, near Boll. A large upper postclavicular scale is conspicuous, and the smoothness of the upper branchiostegals is shown. A few of the anterior flank-scales exhibit feeble traces of elongated tubercles replacing delicate vertical folds at the anterior border. *Purchased*, 1861.

P. 3689. Another large specimen wanting the fins, much distorted; Ohmden, near Boll. The smooth extremity of the rostrum is shown, and most of the external ornament is well-preserved, extending both over the opercular and supratemporal plates. Between the rami of the mandible some of the broad branchiostegals and remains of the gular plate are conspicuous, all quite smooth. *Enniskillen Coll.*

20659. Part of the head and abdominal region of a smaller fish, with paired fins; Boll. Biserial fulcra are seen on the pectoral fin, and some of the broad smooth branchiostegal rays are exposed. *Purchased*, 1846.

P. 7175. A fine specimen 0·28 in length, exposed from the lateral and partly ventral aspect, imperfect in the dorsal region; Holzmaden, Würtemberg. The opercular plates, with the smooth branchiostegals and gular below, are displayed; and all the fins are shown except the dorsal.

Purchased, 1894.

P. 860–1, P. 2023. A fine portion of the abdominal squamation, from Boll; and two imperfect heads with remains of the trunk and fins, from Ohmden, near Boll. *Egerton Coll.*

22534. Imperfect head, pectoral fin, and anterior abdominal scales; Boll. *Purchased*, 1848.

19655–56. Greater portion of trunk in impression, and imperfect remains of another specimen preserved from the origin of the dorsal fin backwards; Boll. There are no distinct traces of vertebral rings in the caudal region, although circumstances are favourable to the exposure of these if they were present in the second specimen.

Purchased, 1845.

P. 3690. Very imperfect but typical large specimen; locality doubtful, but labelled "Lower Lias, Lyme Regis."

Enniskillen Coll.

Ptycholepis gracilis, Davis.

1884. *Ptycholepis gracilis*, J. W. Davis, Ann. Mag. Nat. Hist. [5] vol. xiii. p. 335, pl. x.

Type. Nearly complete fish; J. W. Davis Collection, Halifax.

A comparatively slender species of moderate size, the length of the head equalling the maximum depth of the trunk and contained nearly five times in the total length of the fish. Scales differing from those of the type species in the presence of a few feeble but conspicuous vertical folds of ganoine at the anterior overlapped border.

Form. & Loc. Lower Lias: Dorsetshire.

39864. Remains of a much abraded small head and trunk with pectoral fins; Lyme Regis. *Purchased*, 1866.

P. 4242. Much crushed remains of a large trunk with paired fins: Lyme Regis. Two of the enlarged pelvic scales are shown.

Enniskillen Coll.

P. 859. Imperfect remains of a large specimen doubtfully of this species, probably referred to by Egerton, Figs. & Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv.), no. 8, p. 3; Lyme Regis. The detached left suboperculum, exposed from the inner aspect, exhibits no ascending anterior process. *Egerton Coll.*

Ptycholepis ex. aff. *curtus*, L. Ruger, Centralb. f. Min. Dec. 1924 (No 23) p. 726 t. figs 1-2.

1939. *Pt. curta*, J. Brough, Trans. Fishes Besano p. 66, ff. 30-31 (Rest.) 45.

Ptycholepis curta, Egerton.

[Plate X. fig. 1.]

1854–55. *Ptycholepis curtus,* Sir P. Egerton, Ann. Mag. Nat. Hist. [2] vol. xiii. p. 435, and Figs. & Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv.), no. 8, pl. viii. Suppl. p. 1.

Type. Crushed fish ; British Museum.

A stout species of moderate size, the length of the head equalling the maximum depth of the trunk and contained about three-and-a-half times in the total length. Pelvic fins opposed to the hinder portion of the dorsal ; anal fin very small and remote. External bones and fin-rays ornamented as in the type species ; the scales differing in the presence of a few conspicuous vertical folds of ganoine at the anterior overlapped border.

Form. & Loc. Lower Lias : Dorsetshire. ? ?Baden.

P. 6334. The type specimen, apparently somewhat shortened by crushing ; Lyme Regis. A few ossified vertebral rings, with their robust hæmal arches, are seen at the base of the tail. *Beckles Coll.*

39493. A more satisfactorily preserved fish, shown of the natural size in Pl. X. fig. 1 ; Lyme Regis. The caudal pedicle is accidentally elongated and the hinder portion of the dorsal fin is wanting, but the specimen is otherwise nearly complete. The maxilla distinctly shows a series of minute conical teeth, while the characteristic form of the operculum and suboperculum may be observed. The uppermost branchiostegal ray is conspicuously ornamented. *Purchased,* 1865.

P. 3692. Imperfect example of a similar fish, evidently the second specimen described by Egerton, *loc. cit.* Suppl. p. 1 ; Lyme Regis. Portions of the smooth branchiostegals and gular plate are shown ; and there is evidence of biserial fulcra on the pectoral fin. *Enniskillen Coll.*

P. 3692 a. A small, much-abraded specimen ; Lyme Regis. *Enniskillen Coll.*

P. 859 a. Imperfect remains of head and squamation ; Lyme Regis. Many of the scales are exposed from within, and demonstrate the absence of an internal rib. *Egerton Coll.*

P. 3693. A vertically crushed fish, probably of this species, exhibiting the small teeth in the maxilla; Lyme Regis.
Enniskillen Coll.

Ptycholepis monilifer, sp. nov.

[Plate X. figs. 2–4.]

Type. Portions of fish; British Museum.

The largest known species, probably attaining a length of not less than 0·6. The ridged ornament of the head fine and closely arranged, vermiculating, the ridges often interrupted and in part passing into tubercles. The stouter fin-rays ornamented with few oblique ridges of ganoine. Scales marked with numerous sharp, delicate ridges, sometimes branching, sometimes intercalated, the majority directed obliquely downwards and backwards and terminating in the serrations of the hinder border; the ridges in all the scales, except those of the caudal pedicle, passing forwards into a small sparsely tuberculated area at the anterior margin.

Form. & Loc. Lower Lias: Dorsetshire.

39868. Type specimen, comprising the right mandibular ramus, part of the branchiostegal apparatus, the dorsal and caudal fins, numerous scales, and other fragments; Lyme Regis. The right mandibular ramus is shown of the natural size in Pl. X. fig. 2, but is imperfect posteriorly. A few small robust conical teeth in single series occur sparsely arranged at irregular intervals within the alveolar border, which exhibits a slightly sigmoidal curvature. The anterior extremity of the ramus is stout, though tapering to a blunt point; and this part is much more coarsely ridged than the remainder of the external surface. The superficial ridges are very irregular, frequently interrupted, branching, or intercalated, having a generally backward and downward direction; and for a considerable space bordering the alveolar margin they are replaced by fine tubercles. Part of the course of a sensory canal is conspicuous postero-inferiorly; and a branch seems to extend from this upwards and forwards to the anterior extremity of the bone. The remains of the opercular bones are very fragmentary, but one highly-ornamented plate is evidently the suboperculum, and this is accidentally overlain by the large gular, which is quite smooth except in a small mesial tuberculated area; but several of the long and narrow branchiostegal rays are

exhibited, and distinctly marked with the finely ridged, partly tuberculated ornament. A few slender rays gradually increasing in length occur in front of the dorsal fin, but there are no fulcra; the stouter rays are much ornamented, as shown in the enlarged figure, Pl. X. fig. 4. The caudal fin is large and much forked, with stout rays anteriorly but very delicate rays behind; the superior fulcra are well developed, much elongated, and ornamented with short transverse rugæ of ganoine; and the upper caudal lobe was evidently somewhat produced as usual in the genus, though the specimen is crushed and difficult of precise interpretation. Three scales from the region of the dorsal fin are shown enlarged in Pl. X. fig. 3, and the lowermost exhibits the feeble rudiment of a peg-and-socket articulation. *Purchased*, 1866.

Ptycholepis minor, Egerton.

1852. *Ptycholepis minor*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv.), no. 7, pl. vii.

Type. Imperfect fish; British Museum.

A small elongated species, the length of the head with opercular apparatus somewhat exceeding the maximum depth of the trunk and occupying about one-quarter of the total length of the fish. The ornament of the external bones consisting of comparatively delicate, well-spaced ridges; the scales with few longitudinal furrows, sometimes partly convergent behind, and with some conspicuous vertical folds at the anterior border.

The feeble nature of the external ornament seems to be characteristic of this species, but it may be partly a deceptive appearance due to the state of fossilization.

Form. & Loc. Lower Lias: Leicestershire.

P. 574, P. 3694. Type specimen, about 0·095 in length, in counterpart; Barrow-on-Soar. *Egerton & Enniskillen Colls.*

P. 862. Part of the head, abdominal region, and pectoral fin of a much larger fish; Barrow-on-Soar. *Egerton Coll.*

Ptycholepis avus, Kner.

1866. *Ptycholepis avus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. p. 167, pl. ii. fig. 2.

Type. Distorted fish; Geological Survey Museum, Vienna.

A very small species, attaining a length of about 0·09. Length of the head with opercular apparatus somewhat exceeding the maximum

depth of the trunk, and occupying about one-quarter of the total length of the fish. The ornament of the external bones consisting of closely arranged prominent ridges; the scales with strongly marked longitudinal ridges and furrows terminating in posterior denticulations, and with some conspicuous vertical folds at the anterior border.

Form. & Loc. Upper Trias: Raibl, Carinthia.

P. 5958. A typical specimen wanting all the fins except the dorsal and caudal, but displaying the squamation.

Purchased, 1889.

Ptycholepis marshi, Newberry.

1878. *Ptycholepis marshii*, J. S. Newberry, Ann. New York Acad. Sci. vol. i. p. 127.

1888. *Ptycholepis marshii*, J. S. Newberry, Foss. Fishes Trias, N. Jersey & Connecticut (Mon. U.S. Geol. Surv. no. xiv.), p. 66, pl. xix. figs. 1, 2.

Type. Nearly complete fish; Amer. Mus. Nat. Hist.

A species of slender proportions, attaining a length of about 0·2. Head with opercular apparatus occupying somewhat less than one-quarter of the total length of the fish. Ornamental rugæ on cranial roof slightly radiating; those of the facial and opercular bones more or less parallel and forked. Dorsal fin far forwards, and pelvic fins arising opposite its hinder extremity. Scales exhibiting only longitudinal ridges and furrows, and the hinder border often deeply serrated. (*Newberry.*)

Form. & Loc. Trias: Durham, Connecticut, U.S.A.

Not represented in the Collection.

Some detached scales from the Upper Trias of Besano, Lombardy, are also named *Ptycholepis barboi* by F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. (1886), p. 38. [Milan Mus.].

The so-called *Ptycholepis tenuisquamata* (R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. lvi. pt. i. 1867, p. 913, pl. iv.) from the Upper Trias of Raibl, Carinthia, apparently does not belong to this genus.

Genus **OSTEORACHIS,** Egerton.

[Quart. Journ. Geol. Soc. vol. xxiv. 1868, p. 500.]

Syn. *Isocolum*, Sir P. Egerton, *ibid.* 1868, p. 501.
Harpactes, Sir P. Egerton (*non* Templeton, 1834), Geol. Mag. [2] vol. iii. 1876, p. 441.
Harpactira, Sir P. Egerton, *ibid.* 1876, p. 576.

Trunk elongate. External bones ornamented with tuberculations or rugæ; marginal teeth relatively large and well-spaced; splenial

1908. Ptycholepis marshi, L. Hussakof, Bull. Amer. Mus. Nat. Hist. vol. xxv. p. 95, pl. vi.

1911. Ptycholepis marshi, C. R Eastman, Bull. 18, Connect. Geol. & N.H. Survey, p. 473 pls. vii, viii.

Ptycholepis? sp. F. Priem. Ann. de Pal XIII, 118, xvii f2. 2a. [Trias: Madagascar].

Ptycholepis barboi, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 124, pl. ix. fig. 9. H. Aldinger 1937; p. 265. Hs. 86♀, 87, 88♀, 89 (same Bpl. specimens.) V. Brough 1939; p. 58, Fig. 25-29, 44♀, 46♀, pl. i: f. 3-5.

1897. *Osteorhachis macracephalus*, A. S. Woodward,
Ann. Mag. Nat. Hist. [6] vol. xix, p. 385.

and ectopterygoid teeth smaller, very long and slender, and forming a dense cluster throughout the length of these elements; suboperculum of moderate size, about half as large as the nearly rectangular operculum. Ossifications in the sheath of the notochord in the form of distinct hypocentra and pleurocentra. Fulcra present on all the fins; distal articulations of fin-rays very close. Pectoral much exceeding the pelvic fins in size, but the latter large; dorsal and anal fins triangular in shape, the former opposite the pelvic fins, the latter immediately behind it; caudal fin forked. Scales thin, moderately overlapping, and with a large peg-and-socket articulation; their exposed face ornamented with tuberculations and striæ; principal flank-scales about as deep as broad, several on the ventral aspect much broader than deep. Lateral lines inconspicuous.

Osteorachis macrocephalus, Egerton.

(?) 1839–44. *Pachycormus*? *macrurus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 113, pl. lviii. *a*, fig. 3. [Imperfect tail; Oxford Museum.]

1868. *Osteorachis macrocephalus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxiv. p. 500.

1872. *Osteorachis macrocephalus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv.), no. 5, pl. v.

1876. *Harpactira* (*Harpactes*) *velox*, Sir P. Egerton, Geol. Mag. [2] vol. iii. pp. 441, 576. [Fish; British Museum.]

1885. *Heterolepidotus grandis*, J. W. Davis, Journ. Linn. Soc., Zool. vol. xviii. p. 293, pl. vii. [Fish; J. W. Davis Collection, Halifax.]

1890. *Harpactira velox*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 92.

1890. *Osteorhachis macrocephala*, Woodward & Sherborn, *ibid.* p. 136.

1890. *Platysiagum grandis*, Woodward & Sherborn, *ibid.* p. 151.

1895. *Osteorachis macrocephalus*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 204, pl. vii. fig. 10.

Type. Imperfect head and abdominal region; British Museum.

The type species, attaining a length of about 1 metre. Form and proportions imperfectly known, but the length of the head with opercular apparatus probably contained about four times, and the maximum depth of the trunk seven times in the total length of the fish. Most of the external bones ornamented with a very fine and close granulation; jaws smooth. Operculum considerably deeper than broad. The suboperculum is more than twice as broad as deep in specimen no. P. 3648, and the gular plate in the same individual is about two-thirds as broad as long. Dorsal fin with not less than 18 rays, arising in advance of the middle point of the

back; anal fin much smaller than the dorsal. Scales finely and closely tuberculated; the tubercles only rarely fusing into transverse striæ on the hinder half of the scale.

Form. & Loc. Lower Lias: Dorsetshire.

P. 3654. The type specimen, being the head and greater portion of trunk, vertically crushed, described and figured by Egerton, *loc. cit.* 1872; Lyme Regis. Both description and figure are unsatisfactory. The head is crushed obliquely and exposed from below. Remains of a large gular plate appear between the fragments of the smooth mandibular rami, and there are clusters of the small slender teeth. The premaxilla cannot be identified with certainty, and there is no evidence as to how the teeth were disposed; one narrow fragment of bone shows the bases of three series of teeth. On one large expanded bone, which may be entopterygoid, the teeth cover an extensive area and are in part merely fine granulations. The hyomandibular is well shown on one side, but in the published drawing it is not distinguished from an adjoining element which appears to be the displaced metapterygoid. The process of the hyomandibular for the support of the operculum is long, but its hinder end is connected with the upper and lower extremities of the element by a thin lamina of bone. Behind the hyomandibular, parts of the operculum and subopercular are seen from within. The vertebral centra are not "completely ossified," but are represented merely by distinct hypocentra and pleurocentra; their arches are obscurely indicated through the displaced squamation. The tubercles on the scales are occasionally elongated, and on the hinder portion of some of the flank-scales they are observed to pass into transverse striæ which terminate in feeble denticulations. The fins are too fragmentary for detailed description. *Enniskillen Coll.*

P. 876 x. Fragmentary remains of head, pectoral fins, and anterior scales; Lyme Regis. Part of the smooth outer face of the left dentary, with its coronoid elevation, is shown; and there are scattered examples of the characteristic slender teeth. The cranial roof is imperfectly exposed from within, and there are remains of the hyomandibular, supposed entopterygoid, and numerous other elements. The operculum, though fragmentary, is clearly deeper

than broad, and much broader below than above, while its external face is finely and closely tuberculated. The basals of the pectoral fins are long and slender, constricted mesially, and more than six in number. Appearances are not quite clear, but the largest basal seems to be the hindermost. Some of the scales exhibit the very large peg-and-socket articulation; and others are finely ornamented, showing the tubercles passing into striæ posteriorly. *Egerton Coll.*

P. 3655. Imperfect trunk noticed by Egerton, *loc. cit.*; Lyme Regis. The specimen is much disturbed by crushing, and so probably does not afford a correct idea of the form of the fish, the caudal pedicle being deepened and the fins somewhat displaced and fragmentary. There are separate hypocentra and pleurocentra, as in the type specimen, none fused together. Each hypocentrum in the abdominal region is semicircular, flattened and indented with two longitudinally-elongated pits on its inferior face, bearing a pair of short lateral processes for the support of the ribs. The pleurocentra are too imperfectly shown for description. There are remains of the much-elongated basals of the pectoral fin, and one of the robust, hour-glass-shaped pelvic bones is preserved. The median fins are in great part destroyed. The scales are shown in undisturbed order dorsally for some distance in advance of the dorsal fin; and many narrow scales of the ventral aspect are exhibited. The scale-ornament is well preserved, and the tubercles rarely pass into striæ on the hinder half of the scale. *Enniskillen Coll.*

P. 3648. Type specimen of the so-called *Harpactira* (*Harpactes*) *velox*, described by Egerton, *loc. cit.*; Lyme Regis. This is a curiously preserved specimen about one metre in length, with remains of all the fins except the anal nearly in position, but wanting the whole of the axial skeleton of the trunk, and showing only a few traces of the squamation. The head is very imperfect and obliquely crushed. The greater part of the right mandibular ramus is exhibited from the inner aspect. The dentary is much fractured in front, though showing the coronoid elevation behind; while the splenial is displaced, but sufficiently complete to exhibit its clustered small slender teeth and the excavation of its hinder margin. Some of the charac-

teristic teeth are also scattered below the jaw. The right hypohyal occurs, both large and robust. The large gular plate is completely preserved, two-thirds as broad as long, obtusely rounded in front, truncated behind. There are no other recognizable elements worthy of note, and the amount of disturbance to which the fossil has been subjected is indicated by the fact, that the left subopercular is displaced to the hinder part of the caudal region. The exposed portion of this plate is slightly more than twice as broad as deep, ornamented with a very fine and close tuberculation; and there is a small ascending process at its antero-superior angle. Remains of the pelvic fins opposed to the dorsal appear to comprise some slender fulcra. The caudal fin is best preserved, exhibiting its bifurcation and the very close articulation of its stout rays; fulcra are displayed on both lobes, those on the upper lobe being especially large and distinctly uniserial at the base. Scales occur sparsely in the region of the pelvic, dorsal, anal, and caudal fins, all exhibiting the characteristic tubercular ornamentation. On the few principal flank-scales which are preserved, the tubercles have a tendency to elongation and pass in the hinder half into conspicuous striæ. The peg and socket for articulation are very large, as usual. The ventral scales are shown to have been narrowed, as also are those immediately covering the base of the caudal fin-rays.

Enniskillen Coll.

P. 3649. Fragments of mandible, apparently of this species, labelled *Eugnathus polyodon* by Agassiz and noticed by Egerton, *loc. cit.* 1868, p. 500; Lyme Regis. *Enniskillen Coll.*

P. 3648 a. Imperfect and abraded large cranium, doubtfully of this species; Lyme Regis. *Enniskillen Coll.*

P. 875. Roof of a similar but much smaller skull, with a pair of otic bones displaced behind; Lyme Regis. *Egerton Coll.*

Osteorachis granulatus (Egerton).

1868. *Isocolum granulatum*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. xxiv. p. 501.

1872. *Isocolum granulatum*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv.), no. 4, pl. iv.

Type. Trunk wanting head and tail; British Museum.

A fish known only by a single specimen about half as large as

P. 7797. Type specimen of *Heterolepidotus grandis*, Davis, described & figured loc. cit., further described by A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. xix (1897), p. 385.

Davis Coll.

Osteorhachis leedsi, A.S.W.

1897. Osteorhachis leedsi, A.S. Woodward, Ann. Mag. N. H. [6] vol. xix, p. 379, pls. x, xi.

Type. Remains of head & trunk; British Museum.

Restn. of head of Caluroo, Rayner 1941, Brit. Rec. 16 m p. 222 ff. 2 a, b. Remove. ff. 12A.

P. 8388. Type specimen, desc. & fig. loc. cit.; Oxford Clay, Peterborough. Leeds Coll.

the preceding species, but very doubtfully distinct from the latter although made the type of another genus (*Isocolum*) by Egerton. The specimen is not much smaller than no. P. 3655 recorded above, but its vertebral elements and scales are both less robust. The suboperculum is deeper in proportion to its width; and the striated character of the hinder half of the scales appears to be more general.

Form. & Loc. Lower Lias: Dorsetshire.

P. 3653. The type specimen described and figured by Egerton, *loc. cit.*; Lyme Regis. The operculum is somewhat deeper than broad and completely covered with granulations, which are coarsest near the superior margin. The ossifications in the notochordal sheath are confined to separate pleurocentra and hypocentra; and the thick, sigmoidally-bent neural spines in the abdominal region are not fused with their comparatively delicate supporting arches. The ribs are short and delicate, while the neural and hæmal arches in the caudal region are especially robust. The slender fulcra on the dorsal and pelvic fins appear to be biserial. The squamation is very little disturbed, and the narrowing of the scales on the ventral aspect is well shown; many of the principal flank-scales are finely denticulated. *Enniskillen Coll.*

Genus **CATURUS**, Agassiz.

[Neues Jahrb. 1834, p. 387.]

Syn. *Uræus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1833, p. 12 (non *Uræus*, Wagler, 1830).
Conodus, L. Agassiz, *ibid.* vol. ii. pt. ii. 1844, p. 105 (name only).
Strobilodus, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. 1851, p. 75.
Endactis, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv. 1858), no. 4.
Thlattodus, R. Owen, Geol. Mag. vol. iii. 1866, p. 55.
Ditaxiodus, R. Owen, *ibid.* p. 107.

Trunk elongate-fusiform. External head-bones and opercular bones feebly ornamented with rugæ and tuberculations, all except the cheek-plates robust; snout obtusely pointed, and maxilla straight or with a slightly concavely-arched dentigerous border; teeth relatively large and arranged in a sparse series on the margin

of the jaws, smaller on the palatine and on the splenial, where they are in single series anteriorly, minute and almost granular on the other inner bones; preoperculum nearly smooth and narrow; operculum deep, much broader below than above, and suboperculum of moderate size. Ossifications in the sheath of the notochord insignificant or absent in the smaller species, consisting only of separate hypocentra and pleurocentra in the largest species; ossified ribs slender, not reaching the ventral border of the abdomen. Fulcra biserial, well-developed on all the fins, those of the pectoral being especially elongated and sometimes in part fused together. Pectoral much exceeding the pelvic fins in size, but the latter well-developed; dorsal and anal fins triangular in shape, the former arising opposite or immediately behind the pelvic fins; caudal fin deeply forked. Scales delicate, smooth, feebly crimped or in part tuberculated, deeply overlapping, and none much deeper than broad; a few series anteriorly quadrangular and possibly sometimes united with peg-and-socket, the others more or less cycloidal, and very few narrowed on the ventral aspect of the fish. Lateral line inconspicuous.

The osteology of *Caturus* as exhibited partly in specimens from the French and German Lithographic Stone, but especially in those from the English Oxford Clay, is proved to be essentially similar to that of *Eugnathus* already described (p. 287). The state of preservation of the Oxfordian fossils in the Leeds Collection, however, permits the determination of a few additional features. In advance of the basipterygoid process of the parasphenoid there is a very large alisphenoidal ossification, much exceeding in size either of the otics behind. The prootic is equally well ossified, and the opisthotic is still more robust; but no undoubted traces of pterotic and epiotic ossifications have hitherto been observed. As in *Eugnathus*, the mesethmoid appears to have been little ossified, and it was probably small. In front of the parasphenoid there is a pair of large vomers, bearing a few teeth only at their anterior end. The nasals are proved to resemble those of *Amia*. The supraorbitals are irregular and much subdivided at their outer margin, the tesseræ extending somewhat upon the cheek. The symplectic in *Caturus* still remains unknown; but the palatine has been well observed in this genus, forming a small laterally compressed plate of bone with a row of teeth on its oral margin. The ceratohyal does not exhibit so much evidence of twisting as in *Eugnathus*. The gill-filaments have calcified supports, and there are small tooth-like gill-rakers, some arranged on the edge of little triangular flakes of bone like those observed in *Amia*.

1941

Fossil (Lepidolepis) J. Virlet, Bull. mémoires Soc. Linn. Lyon. 10, 4 64.

Calunda de Peterborough, J. P. Lehmann 1848, Arkiv Zool. K. Sv. Vet. Akad. Handl. (4) 1, 2. pl. viii.

For osteology of Catunus, see A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. xix (1897), pp. 292–297, pls. viii, ix. also

Catunus groenlandicus, s.n. H. Aldinger, 1932, Medd. Grønland Komm. Videnskr. Undersg. Grønlands. LXXXVI. No. 4. 8 pp. 3 pls. Portlandian. Greenland. Head partly articulated with trunk.

Neurocranium D. M. Rayner 1948 Phil. Tr. R. S. 233 B. p. 289, pls. 4.

Slightly amended restoration of *Caturus* published by A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 82, text-fig. 26.

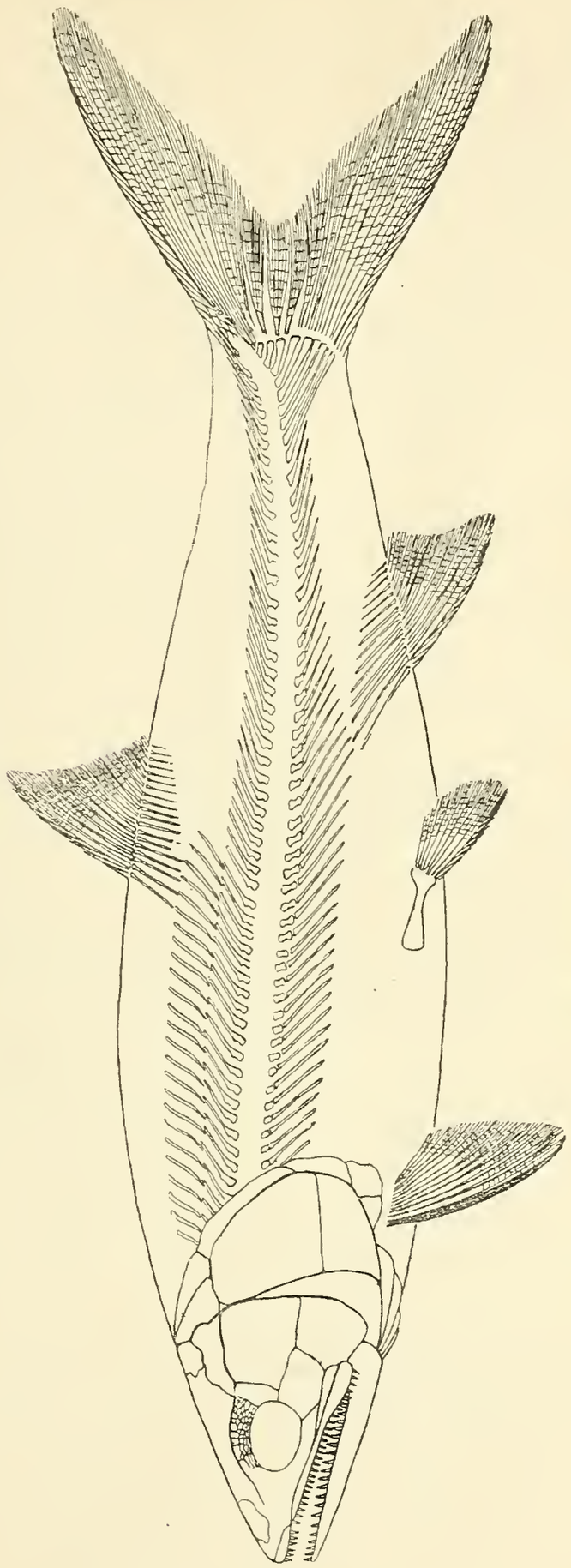


Fig. 36.

Caturus furcatus; restoration, scales omitted.

Caturus furcatus (Agassiz).

1833. *Pachycormus furcatus*, L. Agassiz, Neues Jahrb. p. 476, and Poiss. Foss. vol. ii. pt. i. p. 11.
1833. *Uræus nuchalis*, L. Agassiz, Neues Jahrb. p. 477, and Poiss. Foss. vol. ii. pt. i. p. 12.
1834. *Caturus latus*, G. von Münster, Neues Jahrb. p. 539. [Nearly complete fish ; Palæontological Museum, Munich.]
1834. *Uræus furcatus*, L. Agassiz, Verhandl. Ges. Vaterländ. Mus. Böhmen, p. 70.
1839. *Caturus maximus*, L. Agassiz, Neues Jahrb. p. 118.
1839. *Caturus macrodus*, L. Agassiz, *ibid.* p. 118. [Fragmentary fish ; Palæontological Museum, Munich.]
1839–44. *Caturus latus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 117, pl. lvi.
1842–44. *Caturus furcatus*, L. Agassiz, *ibid.* pt. ii. p. 116, pl. lvi. *a*.
1844. *Caturus maximus*, L. Agassiz, *ibid.* pt. ii, pp. 118, 294.
1844. *Caturus macrodus*, L. Agassiz, *ibid.* pt. ii. pp. 118, 294.
1844. *Caturus nuchalis*, L. Agassiz, *ibid.* pt. ii. p. 293.
1863. *Caturus maximus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 700.
1863. *Caturus furcatus*, A. Wagner, *ibid.* p. 701.
1863. *Caturus latus*, A. Wagner, *ibid.* p. 702.
1863. *Caturus cyprinoides*, A. Wagner, *ibid.* p. 702. [Nearly complete fish ; Palæontological Museum, Munich.]
(?) 1873. *Caturus furcatus*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 18, pl. xiii. fig. 1.
(?) 1873. *Caturus latus*, V. Thiollière, *ibid.* p. 18, pl. xiii. fig. 3.
1881. *Caturus furcatus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 109.
1887. *Caturus maximus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 228, fig. 241 *a*.
1887. *Caturus furcatus*, K. A. von Zittel, *ibid.* p. 228, figs. 241 *b–g*.
1887. *Caturus elongatus*, K. A. von Zittel, *ibid.* p. 227, fig. 240 (*errore*).

The small fishes described under the following names also appear to be immature examples of this species :—

1833. *Uræus macrurus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12.
1839. *Caturus microchirus*, L. Agassiz, Neues Jahrb. p. 118. [Skull and pectoral fin ; Palæontological Museum, Munich.]
1842. *Caturus obovatus*, G. von Münster, Neues Jahrb. p. 44. [Small distorted fish ; Palæontological Museum, Munich.]
1844. *Caturus macrurus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 118.
1844. *Caturus microchirus*, L. Agassiz, *ibid.* pp. 118, 294.
1861. *Caturus ferox*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 56, fig. 10. [Teyler Museum, Haarlem.]

1906. Caturus furcatus, E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 194, pl. xxiv, pl. xxviii. fig. 1; ? also C. cf. furcatus, ibid. p. 199, text-figs. 10–13.

1896. Caturus furcatus, H. Scupin, Archiv f. Naturgesch. vol. i. p. 174, pl. x. fig. 11.

1914. Caturus furcatus, C. R. Eastman, Mem. Carnegie Inst. vol. vi. p. 373, pl. lv. fig. 1; also p. 411, pl. lix. fig. 3, lx. fig. 2, lxi. figs. 4, 5, lxviii. fig. 1, lxxii. fig. 3, lxxxiii, fig. 3.

1932. C. f., T. Edinger, Senck. u. Museum, LXII. p. 171, t. 4. K. Sv. vet. Akad. Handl. (4) 1. no 3

1948. C. f., J-P. Lehman ~~Bull. Inst. Roy. Hist. Nat. Belg.~~ pl. ix f. 3.

1949. C. f., P. de Saint-Seine N. Arch. Mus. N.H. Lyon 2 p. 165 figs. 73, pl. xvi f. C.

1951. C. f. T. Gorič Arkiv Zool. (2) 3 (7) 5 illustr.

1863. *Caturus microchirus*, A. Wagner, Abh. k. bay. Akad. Wiss. math.-phys. Cl. vol. ix. p. 703.
1863. *Caturus macrurus*, A. Wagner, *ibid.* p. 706.
1863. *Caturus obovatus*, A. Wagner, *ibid.* p. 707.
1863. *Caturus gracilis*, A. Wagner, *ibid.* p. 707. [Variety in Palæontological Museum, Munich.]
1871. *Caturus ferox*, T. C. Winkler, Archiv. Mus. Teyler, vol. iii. p. 176 pl. v. figs. 2, 3.

Type. Nearly complete fish; Royal Bohemian Museum, Prague.

The type species, attaining a length of about 1 metre. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and usually less than one-quarter of the total length of the fish. Caudal region tapering to a comparatively slender pedicle, its depth little, if at all, exceeding one-third the maximum depth of the abdominal region. Teeth large, with very slender apex, and about 40 in total number in the dentary; depth of operculum somewhat exceeding its maximum breadth; branchiostegal rays about 24. Dorsal fin with about 20 rays, deeper than long, its depth equalling about one-half that of the trunk at its origin; this fin arising in advance of the middle of the back, the distance from the occiput to its origin being equal to that from its hinder border to the base of the caudal fin. Pelvic fins arising opposite the front half of the dorsal fin; anal fin smaller than the dorsal, with from 12 to 14 rays. Scales smooth, or in part marked with a few feeble, short, transverse striæ.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria, and (?) Ain, France.

37024, 37026. Two fine specimens nearly 0·5 in length, in counterpart; Solenhofen. The vertebral pleurocentra and hypocentra are well developed, and the first specimen exhibits the large gular plate with about 21 branchiostegal rays. *Häberlein Coll.*

P. 3726. Similar specimen; Solenhofen. *Enniskillen Coll.*

49141. Plaster cast of large specimen (Palæontological Museum, Munich) apparently elongated by crushing; Kelheim. *Purchased*, 1878.

37028, 37034, 37038. Three specimens from 0·36 to 0·42 in length; Solenhofen. The last specimen shows the atrophied upper caudal lobe. *Häberlein Coll.*

37027. Imperfect fish 0·32 in length, in counterpart, with indications of ossified pleurocentra and hypocentra; Solenhofen.

The small teeth of the splenial bone are displayed within the remains of the large series on the dentary.
Häberlein Coll.

37035. A much-fractured specimen 0·28 in length, showing ossified pleurocentra and hypocentra and a relatively large dorsal fin; Solenhofen. *Häberlein Coll.*

P. 908. A finely preserved, though partly fractured specimen, 0·28 in length, not exhibiting either pleurocentra or hypocentra; Solenhofen. The series of large postclavicular scales is preserved; and some of the scales in the dorsal part of the caudal region show the striation and crimping at their hinder margin. *Egerton Coll.*

P. 5544. Fragmentary and distorted remains of a large fish; Eichstädt. *By exchange*, 1888.

P. 6941. Imperfect fish about 0·4 in length, displaying the left pectoral fin and the very stout hæmal arches of the caudal region; Eichstädt. *By exchange*, 1893.

P. 7180. Imperfect large specimen; Eichstädt. *By exchange*, 1894.

P. 909. Portion of trunk, displaying pelvic bones; Kelheim.
Egerton Coll.

37035 a. Imperfect head and abdominal region; Solenhofen.
Häberlein Coll.

P. 519. Imperfect head and other remains, in counterpart, with well-displayed dentition, labelled "*Caturus macrodus*, Agass." in Agassiz's handwriting, and apparently intended to be the type specimen of that supposed distinct species; Solenhofen. *Egerton Coll.*

P. 904, P. 907. Two specimens showing more fragmentary remains of the head, the second also with the clavicles and pectoral fins; Solenhofen. *Egerton Coll.*

37906. Fine skull, with scattered bones; Solenhofen.
Häberlein Coll.

P. 904 a, P. 3722 a. Imperfect skull, in counterpart; Solenhofen.
Egerton & Enniskillen Colls.

8038. Fragmentary remains of head; Solenhofen. *Mantell Coll.*

37929. Mandible with gular plate; Solenhofen. *Häberlein Coll.*

P. 908. Subdivided upper circumorbital plates noticed by A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol xix (1897), p. 294.

P. 3722 a. Slab with scattered fragmentary remains, including the head; Solenhofen. *Enniskillen Coll.*

20560. Large caudal fin; Solenhofen. *Purchased.*

20577–78. Two large slabs with scattered fragmentary remains; Solenhofen. *Purchased*, 1846.

P. 4378–9. Two slabs with scattered fragmentary remains; Solenhofen. *Enniskillen Coll.*

The following specimens are probably immature examples of this species :—

P. 7566. Fine specimen, 0·23 in length; Pappenheim. *History unknown.*

37095, 37097, 37812. Three fine specimens, in counterpart, from 0·145 to 0·165 in length; Solenhofen. The depth of the dorsal fin seems to be relatively greater than in the typical large specimens. *Häberlein Coll.*

37083, 37808–09. Four fine smaller specimens; Solenhofen. *Häberlein Coll.*

P. 4380. Fish about 0·16 in length, with caudal fin broadened by crushing; Kelheim. *Enniskillen Coll.*

42844. Impression of fish 0·135 in length; Solenhofen. *Van Breda Coll.*

P. 906. Impression of a similar fish and two smaller specimens; Solenhofen. *Egerton Coll.*

P. 3721, P. 3724, P. 3729. Three imperfect small fishes, and another fine specimen 0·125 in length; Solenhofen. *Enniskillen Coll.*

P. 906 a, P. 3725. Fine specimen 0·095 in length, in counterpart; Solenhofen. *Egerton & Enniskillen Colls.*

37058. Imperfect fish, ventral and partly lateral aspect, in counterpart, probably of this species; Solenhofen. *Häberlein Coll.*

37067. Small head and pectoral fins, ventral aspect, in counterpart; Solenhofen. *Häberlein Coll.*

The following fragmentary specimens indicate a species closely related to *C. furcatus*, but apparently distinguished by the form of the mandible. The depth of the dentary at the hindermost tooth equals one-quarter of the length of its dentigerous border, while

in *C. furcatus* the first measurement is only one-fifth of the second. The specimens are important as exhibiting many features in the osteology of the genus.

P. 6902. Vertically depressed head, exhibiting the nasal bones, tesseræ of supraorbitals, and more than 20 branchiostegal rays; Oxford Clay, Peterborough. *Leeds Coll.*

P. 6903. Remains of head and anterior squamation in nodule; Oxford Clay, Peterborough. *Leeds Coll.*

P. 6904. Vertically depressed head exhibiting the characteristic supraorbitals; Oxford Clay, Peterborough. *Leeds Coll.*

P. 6905–7. Three fragmentary heads, the first displaying the preoperculum, the second the alisphenoid, prootic, and parasphenoid bones, with remains of the branchial arches; Oxford Clay, Peterborough. *Leeds Coll.*

P. 6908, a–c. Four examples of the hinder portion of the skull and adjoining parts; Oxford Clay, Peterborough. *Leeds Coll.*

P. 6910. Associated maxillæ and palatine; Oxford Clay, Peterborough. *Leeds Coll.*

P. 6909. Miscellaneous fragments of trunk and fins; Oxford Clay, Peterborough. *Leeds Coll.*

46348. Two fragments of head; Christian Malford, Wiltshire. *Cunnington Coll.*

29049. Fine large depressed head, with part of the abdominal region and the bases of the pectoral fins; Oxford Clay, Christian Malford. *Purchased*, 1854.

39156–57. Imperfect jaws; Christian Malford. *Bowerbank Coll.*

36174. Maxilla; Christian Malford. *Purchased*, 1861.

P. 967. Imperfect maxilla, and maxilla associated with the mandible; Christian Malford. *Egerton Coll.*

24676. Imperfect remains of head and trunk; Christian Malford. *Purchased*, 1850.

Caturus pachyurus, Agassiz.

1832–33. *Uræus pachyurus*, L. Agassiz, Neues Jahrb. p. 142, and Poiss. Foss. vol. ii. pt. i. p. 12.

1839. *Caturus pachyurus*, L. Agassiz, Neues Jahrb. p. 118.

1844. *Caturus pachyurus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 118.

1844. *Caturus elongatus*, L. Agassiz, *ibid.* pp. 118, 293. [Nearly complete fish; Palæontological Museum, Munich.]

1903. *Caturus elongatus*, L. Coulon, Bull. Soc. Étude Sci. Nat. Elbeuf, 21st. year 1902, p. 150, fig. 5.

1914. *Caturus pachyurus*, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 411, pl. lix.; fig. 1.

1863. *Caturus elongatus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 703.

1863. *Caturus fusiformis*, A. Wagner, *ibid.* p. 704. [Small fish; Palæontological Museum, Munich.]

1863. *Caturus pachyurus*, A. Wagner, *ibid.* p. 704.

1863. *Caturus contractus*, A. Wagner, *ibid.* p. 705. [Nearly complete fish; Palæontological Museum, Munich.]

1871. *Caturus elongatus*, T. C. Winkler, Archiv. Mus. Teyler, vol. iii. p. 178, pl. v. figs. 4–10.

(?) 1873. *Caturus elongatus*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 18, pl. xiii. fig. 2.

Type. Nearly complete fish; Palæontological Museum, Munich.

A small species attaining a length of about 0·3. Length of head with opercular apparatus considerably exceeding the maximum depth of the trunk, and somewhat less than one-quarter of the total length of the fish. Caudal region little tapering, the depth of the caudal pedicle equalling about one-half the maximum depth of the trunk. Teeth large, with slender apex, and irregularly spaced. Dorsal fin with about 18 rays, deeper than long, its depth equalling at least three-quarters that of the trunk at its origin; all the fins situated as in the type species. Scales smooth.

According to Wagner (*loc. cit.* p. 706), the imperfectly described *Caturus granulatus*, Münster (Neues Jahrb. 1842, p. 44), is closely related to this species.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria, and (?) Ain, France.

37076. Well-preserved large trunk, with fins and the branchial region; Solenhofen. *Häberlein Coll.*

37810. Fish 0·235 in length, much fractured, but with nearly complete fins and displaying relatively large, stout teeth in the dentary bone; Solenhofen. *Häberlein Coll.*

22518. Imperfect specimen 0·195 in length, apparently with smaller dentary teeth than the last; Solenhofen.
Purchased, 1848.

P. 903. Similar specimen, wanting the caudal fin; Eichstädt.
Egerton Coll.

49127. Plaster cast of type specimen of *Caturus contractus*, Wagner, the trunk somewhat deepened by crushing; Solenhofen.
Purchased, 1878.

Caturus driani, Thiollière.

1850. *Caturus driani*, V. Thiollière, Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 145.

1873. *Caturus segusianus*, P. Gervais, in V. Thiollière, Poiss. Foss.

Bugey, pt. ii. p. 17, pl. xii. fig. 1. [Nearly complete fish ; Lyons Museum.]

1881. "*Caturus*" *segusianus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 110.

Type. Nearly complete fish ; Lyons Museum.

A large species, attaining a length of about 0·5. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and less than one-quarter of the total length of the fish. Caudal region tapering to a comparatively slender pedicle, its depth equalling about one-third the maximum depth of the abdominal region. Teeth smaller than in the type species. Dorsal fin deeper than long, and its depth nearly or quite equalling that of the trunk at its origin ; this fin arising well in advance of the middle of the back, the distance from the occiput to its origin being considerably less than that from its hinder border to the base of the caudal fin. Pelvic fins arising opposite the hinder half of the dorsal fin ; anal fin much smaller than the dorsal ; lobes of the caudal fin especially slender. Scales larger than in the type species, smooth.

The peg-and-socket articulation of the scales indicated in Thiollière's figure, is not shown in the specimens enumerated below.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone) : Ain, France.

P. 905. Fine large specimen ; Cirin. *Egerton Coll.*

P. 4700. Smaller and more imperfect specimen, the trunk shown chiefly in impression ; Cirin. *Purchased*, 1884.

P. 4697–8. Two imperfect large specimens about 0·54 in length, for the most part shown only in impression, probably of this species ; Cirin. *Purchased*, 1884.

Caturus velifer, Thiollière.

1850. *Caturus velifer*, V. Thiollière, Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 143.

1873. *Caturus velifer*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 17, pl. xii. fig. 2.

1881. "*Caturus*" *velifer*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 110.

Type. Nearly complete fish ; Lyons Museum.

A large species, closely related to *C. driani*, but distinguished by its more elongated trunk, the length of the head with opercular apparatus exceeding the maximum depth of the trunk, and the

949. C. ch. P. de Saint-Seine, N. Arch. Mus. H.N. Lyon 2
p. 159 Hf. 70, 71, pl. xviii f. B.

949. C. v. Saint-Seine (ined). p. 164 Hf. 72.

dorsal fin being relatively large. Scales in part ornamented with radiating series of very fine granulations.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

Not represented in the Collection.

Caturus angustus, Agassiz.

1844. *Caturus angustus,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 118.
1893. *Caturus angustus,* A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. xii. p. 398, pl. xviii. fig. 1.

Type. Fish, wanting head; Worcester Museum.

An imperfectly defined species, known only by the type specimen, which measures 0·16 from the origin of the dorsal to the fork of the caudal fin. Trunk much elongated, the width of the caudal pedicle scarcely equalling half the depth of the trunk between the dorsal and pelvic fins. The origins of these two fins directly opposed, and the dorsal with about 20 rays; anal fin about as large as the pelvic fins, with not less than 12 rays.

Form. & Loc. Portlandian: Garsington, Oxford.

Not represented in the Collection.

Caturus heterurus (Agassiz).

[Plate IX.]

1839–44. *Pachycormus* (?) *heterurus,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 113, pl. lviii. *a.* figs. 4, 5.

Type. Tail; Oxford Museum.

A robust species of medium size, attaining a length of about 0·45. Length of head with opercular apparatus exceeding the maximum depth of the trunk and contained about four times in the total length of the fish; depth of caudal pedicle equalling about half the maximum depth of the trunk. External head-bones, supratemporals, and opercular bones ornamented only in part with feeble rugæ and tuberculations; maxillary teeth small, slender, and in close series, premaxillary teeth larger, and those of the dentary bone largest and stoutest, well-spaced; operculum about three-quarters as broad as deep. Hypocentra and pleurocentra large, well-ossified. Dorsal fin comprising 18 rays, arising in advance of the middle of the back, about as deep as long, and its maximum depth not much exceeding half that of the trunk at its origin; pectoral fins with loose fulcra; pelvic fins arising opposite the front half of the dorsal; anal fin comprising only 9 or 10 rays, arising immediately behind termination of dorsal. Scales relatively large, some exhibiting a very feeble radiating crimping.

It is not improbable that the undefined name *Caturus bucklandi* (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 119) pertains to this species. It was originally applied to a specimen from Lyme Regis exhibiting the head and anterior portion of trunk, but the present writer has not been able to discover this fossil.

Form. & Loc. Lower Lias : Dorsetshire.

All the following specimens were obtained from the neighbourhood of Lyme Regis :—

38121. Head with abdominal region exposed from the left side, shown of one-half the natural size in Pl. IX. fig. 1. The cranium is too much crushed for examination, and the facial bones are mostly imperfect and fractured. The short and deep premaxillæ (*pmx.*) bear a few large slender teeth ; the maxilla (*mx.*) exhibits a close series of small slender teeth, and there is a supramaxillary bone (*s.mx.*). The mandible exhibits very large, widely-spaced teeth in the dentary bone (*d.*), and there are indications of the ascending plate of bone behind the tooth-bearing margin. The form and proportions of the opercular bones (*op.*, *s.op.*, *i.op.*, *p.op.*) are shown, while the large size of the upper branchiostegal ray (*br.*1) and of the gular plate (*g.*) is noteworthy. The left post-temporal (*p.t.*), clavicle, and supraclavicle are partly exhibited, and there are remains of the postclavicular plates. The pectoral fin is nearly complete ; its anterior rays are remarkably straight, and it appears to have been fringed with slender fulcra ; only four rays of the left pelvic fin remain, but the large slender fulcra are well preserved. Of the dorsal fin, only some of the supports are shown. The position of the notochord is marked by a confused line of hypocentra and pleurocentra ; the ribs are long and the neural arches short, but both remarkably slender. Above the neural arches is a series of very robust, slightly bent, long bones, inclined backwards, commencing shortly behind the head and extending even beneath the supports of the dorsal fin ; and these appear to be the separate neural spines. All the scales are smooth, and their rhombic form is well shown in the dorsal region. *Purchased*, 1864.

P. 897. Head and fragment of abdominal region shown from the right side. The dentition is indicated as in the last specimen. *Egerton Coll.*

P. 4377. Remains of head and opercular apparatus in indurated Lias. *Enniskillen Coll.*

P. 2036. Nearly complete skeleton, with imperfect head, and displaying part of the squamation. The thick scales on the atrophied upper caudal lobe are conspicuous, and shown in Pl. IX. fig. 2, *s*. One of the pelvic fin-supports is represented in fig. 3, while a few of the scales of the caudal region are shown enlarged twice in fig. 4. *Egerton Coll.*

P. 3696 b. More imperfect skeleton with obscure remains of the head. The indurated contents of the intestine seem to preserve impressions of the folds of the spiral valve. *Enniskillen Coll.*

P. 3696. The greater portion of a large fish, wanting the tail and the anterior end of the head, and with much-displaced squamation. Large slender fulcra are shown in front of each of the paired fins; and the stout median scales are preserved at the base of the lower lobe of the caudal fin. *Enniskillen Coll.*

P. 3702. Similar specimen, infero-lateral aspect, showing less of the head, but with more satisfactorily preserved squamation. *Enniskillen Coll.*

P. 3696 a. Skeleton of the trunk of a smaller fish, with a few fragmentary head-bones. The squamation is almost destroyed, only a few rhombic scales being shown on the flank of the abdominal region. The hypocentra in the abdominal region are broad and flattened below; those in the caudal region are smaller and firmly united with the robust pedicles of the hæmal arches. The free neural spines are imperfectly exhibited; the supports of the anal fin are remarkably long, and the pelvic basipterygia are well-ossified and robust. *Enniskillen Coll.*

P. 3696 c–e. Three imperfect specimens. *Enniskillen Coll.*

P. 120. Imperfect head and abdominal region, the scales well preserved and displaying the superficial ornament. *Purchased*, 1880.

P. 898 a. Imperfect trunk with well-preserved dorsal fin. *Egerton Coll.*

P. 898 c. Imperfect axial skeleton, with remains of partially digested fish. *Egerton Coll.*

P. 3633. Inferior aspect of head and part of abdominal region of a small fish, probably of this species. *Enniskillen Coll.*

Caturus latipennis (Egerton).

1844. *Pachycormus latipennis*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 114 (undefined).

1858. *Pachycormus latipennis*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 3, pl. iii.

Type. Head, with pectoral fin and scales; British Museum.

An imperfectly definable species closely similar to *C. heterurus*. External head-bones and opercular bones ornamented only in part with feeble rugæ and tuberculations, the supratemporals and post-temporals closely tuberculated; maxillary teeth small, slender, and in close series, and those of the dentary bone large, stout, well-spaced. Hypocentra and pleurocentra distinct, robust. Scales of moderate size, smooth.

The anterior pectoral fin-rays of this species seem to be somewhat broader and more arcuated than in *C. heterurus*.

Form. & Loc. Lower Lias: Dorsetshire.

P. 568. The type specimen, described and figured by Egerton, *loc. cit.*; Lyme Regis. *Enniskillen Coll.*

38527. Similar specimen exposed from the left side; Lyme Regis. The pectoral fin is well-preserved, but there are only slight traces of slender fulcra. *Purchased*, 1864.

Caturus agassizi (Egerton).

1858. *Endactis agassizi*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 4, pl. iv.

Type. Fragmentary head and trunk; British Museum.

The type species of the so-called genus *Endactis*, attaining a length of about 0·3. The proportions being apparently similar to those of *C. heterurus*, it remains doubtful whether the fish is not merely the young of the latter species; but in the specimens mentioned below the scales seem to be relatively smaller and more conspicuously crimped, while ossifications in the notochordal sheath are very feeble or absent. The crimpings on the scales sometimes radiate more or less.

Form. & Loc. Lower Lias: Dorsetshire.

P. 567. The type specimen, very fragmentary, showing the greater part of the squamation of the right side from within; Lyme Regis. There are distinct indications of large

Caturus smithwoodwardi, E. I. White.

1925. Caturus smithwoodwardi, E. I. White, Ann. Mag. N.H. [9]. vol. 15, p. 601, t.-fig. 1, pl. XXX.

1952. C. S W (oic), B. Stauff, Das Holzmadenbuch, p. 25, pl. 56.

Holotype, Nearly complete fish; British Museum.

Paratype Imperfect fish; ibid.

Form. & loc. U. Lias: Holzmaden, Boll.

P. 11127. Holotype. desc.d & fig.d loc. cit p. 602, pl. XXX.; Holzmaden
P. 530. Paratype. descr.d & basiphyt. fig. p. 602 t.-f. 1.; Boll. Purchased, 191
see p. 348. Egerton 611.

fulcra in front of the dorsal fin; and the form of the trunk is evidently somewhat deepened by crushing.

Egerton Coll.

41856. A small fish, 0·24 in length, showing the characteristic ornamentation of the scales, with imperfect head and wanting the greater part of the caudal fin; Lyme Regis. Relatively large teeth are shown in the upper jaw. The neural and hæmal arches of the axial skeleton of the trunk are well calcified, but there are no distinct indications of skeletal elements in the notochordal sheath. Large fulcra are shown on the upper lobe of the caudal, but the other fins are too imperfectly preserved to show whether similar fulcra were present or absent. The ornamentation of the scales is very conspicuous in the abdominal region: there are stouter rhombic scales on the atrophied upper caudal lobe, and two stout median scales occur at the base of the lower lobe of the caudal fin. *Purchased*, 1870.

Caturus insignis (Kner).

1866. *Eugnathus insignis*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. p. 306, pl. i.

Type. Nearly complete fish; Innsbruck Museum.

A species attaining a length of about 0·4. Length of head with opercular apparatus about equal to the maximum depth of the trunk and contained nearly four-and-a-half times in the total length of the fish; depth of caudal pedicle equalling about half the maximum depth of the trunk. External bones ornamented with fine granulations and rugæ; mandibular teeth robust and in part striated; operculum twice as deep as broad. Pelvic fins arising immediately in advance of the dorsal, which arises at about the middle point of the back and comprises 17 rays; anal fin with 11 rays, smaller than the dorsal, and arising opposite the hinder extremity of the latter.

Form. & Loc. Upper Trias: Seefeld, Tyrol.

Not represented in the Collection.

The following species, known only from imperfect specimens, are remarkable for the large size and robust proportions of their teeth. They are commonly described as *Conodus*, *Strobilodus*, *Thlattodus*, and *Ditaxiodus*, but have as yet exhibited no characters by which they can be distinguished from *Caturus*.

Caturus (**Conodus**) **chirotes** (Agassiz).

[Plate VII. figs. 2, 3.]

1839. *Eugnathus cheirotes*, L. Agassiz, Neues Jahrb. p. 118.
1842-44. *Eugnathus chirotes*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 102, pl. lvii. *b*.
1844. *Conodus ferox*, L. Agassiz, *ibid.* p. 105 (name only). [Portion of jaws ; British Museum.]
1890. *Eugnathus* (?) *chirotes*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 77.

Type. Imperfect fish ; British Museum.

The type species of the undefined genus *Conodus*, attaining a length of about 0·75. Length of head with opercular apparatus apparently exceeding the maximum depth of the trunk and contained about four times in the total length of the fish. External bones ornamented in part with sparse tuberculations ; maxilla thick but not much deepened, the hinder two-thirds of its dentigerous margin concavely arched, and the height of the middle teeth not equalling the depth of the bone at their point of insertion ; supramaxilla sparsely tuberculated, half as long as the maxilla ; premaxillary teeth very large, apparently equalling in size those of the middle of the dentary, which are somewhat tumid at the base ; splenial teeth relatively very small and numerous, stout and not much curved ; enamel restricted to the apex in all the teeth. Scales for the most part smooth, but some of those of the flank exhibiting longitudinal crenulations.

Form. & Loc. Lower Lias : Dorsetshire.

P. 3643. The type specimen described and figured by Agassiz, *loc. cit.*; Lyme Regis. The head seems to have been somewhat deepened in the fossil by the upturning and fracture of the cranium, while the jaws are displaced downwards. The otic elements are well-ossified and the thin dermal cheek-plates are conspicuous. The maxilla is much fractured and imperfect, but some of the slender teeth in its hindermost portion are well shown ; one very large tooth on the premaxilla is also preserved. The mandible is obscured, and only one of its moderately large anterior teeth can be seen. The middle portion of the preoperculum is coarsely rugose, and the same ornament appears slightly on other fragments of the external plates. The ossifications in the sheath of the notochord are much crushed, but evidently consist of separate pleurocentra

and hypocentra, the latter with a pair of short processes for the support of the delicate ribs. In the abdominal region the series of curved robust neural spines, separate from the supporting arches, is well exhibited. The imperfect left clavicle is displaced upwards, and the comparatively thin and laminar supraclavicle lies above it. In the remains of the pectoral fin, the stout foremost ray is conspicuous; and the very fine distal subdivision of most of the rays is well shown. One of the pelvic fins occurs almost in its natural position, comprising seven or eight rays, with a series of large fulcra on its anterior margin. About sixteen rays are preserved in the fragmentary dorsal fin, with a few displaced fulcra and thirteen of its basal bones. The caudal fin is too imperfect for description, and the anal is wanting. The squamation is also very imperfect, and the only ornament is observable on some of the scales of the flank, which are crimped much like the scales of *Eugnathus*.

Enniskillen Coll.

P. 3645. An imperfect head, exposed from the right side; Lyme Regis. A fragment of the occipital portion of the cranium occurs behind, and the squamosal is shown to be ornamented with a few sparse tubercles. The cheek-plates are mostly smooth, but sometimes feebly tuberculated and frequently rugose towards the margin. The maxilla (*mx.*) and supramaxilla (*s.mx.*) are shown of the natural size in Pl. VII. fig. 3. The bases of two very large premaxillary teeth are seen, and there is evidence also of equally large teeth in the mandible, which is unfortunately much obscured. The preoperculum is rugose near its hinder margin; while the crushed remains of the operculum and suboperculum exhibit a few small sparse tuberculations. *Enniskillen Coll.*

P. 514. Crushed fragment of jaws, the dentary shown of the natural size in Pl. VII. fig. 2, and intended by Agassiz to be described as the type specimen of *Conodus ferox*; Lyme Regis. Three large dentary teeth are preserved, though somewhat broadened at the base by accidental crushing; and there are the bases of smaller teeth in fragments of the maxilla. The very small and stout splenial teeth are also seen. *Egerton Coll.*

Caturus (**Strobilodus**) **giganteus** (Wagner).

1851. *Strobilodus giganteus*, A. Wagner, Abh. k. bay. Akad. Wiss. math.-phys. Cl. vol. vi. p. 75, pl. ii.
1863. *Strobilodus giganteus*, A. Wagner, *ibid.* vol. ix. p. 674.

Type. Imperfect fish ; Palæontological Museum, Munich.

The type species of the so-called genus *Strobilodus*, attaining a length of nearly 1 metre. Maxilla apparently more robust than in the preceding species, with concave dentigerous border and its middle teeth remarkably large and tumid, their height nearly equalling the depth of the bone at their insertion. Opercular bones finely punctate, wanting tubercular and rugose ornamentation.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone) : Bavaria.

Not represented in the Collection.

Caturus (**Thlattodus**) **suchoides** (Owen).

1866. *Thlattodus suchoides*, R. Owen, Geol. Mag. vol. iii. p. 55, pl. iii.
1887. *Strobilodus suchoides*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 230.
1890. *Strobilodus suchoides*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 190.

Type. Jaws ; British Museum.

The type species of the so-called genus *Thlattodus*, known only by the jaws, which indicate a fish perhaps more than 1 metre in length. Maxilla and its dentition apparently almost similar in form and proportions to that of *C. giganteus*, but less deepened behind. Dentary attenuated and scarcely if at all deflexed at the symphysis. The indent at the base of the external face of the teeth very conspicuous.

Form. & Loc. Kimmeridgian : Norfolk.

41386. Type specimen ; Kimmeridge Clay, Downham, Norfolk. The robust prefrontal articulating with the maxilla is well shown on each side.

Presented by C. B. Rose, Esq., 1869.

Caturus cliftoni, sp. nov.

[Plate VII. figs. 4, 5.]

Type. Imperfect right maxilla ; British Museum.

Maxilla similar in form to that of *C. suchoides*, and at least as large, but the teeth much larger, the height of those at its middle

greater than the depth of the bone at their insertion; all the teeth, both upper and lower, very slender at the apex and often incurved. Symphysial end of the only known dentary bone considerably curved downwards.

Form. & Loc. Portlandian: Isle of Portland. Kimmeridgian: Dorsetshire.

P. 6035. Type specimen, shown of one-half the natural size in Pl. VII. fig. 4; Portland Stone, Isle of Portland. Both bone and teeth are much fractured, but the general form of the maxilla is distinct except at its hinder extremity. The very slender small teeth are indicated posteriorly, and the attenuated incurved apex is also shown on the principal teeth, some of which are fractured to expose the inner cavity. *Presented by George Clifton, Esq.*, 1890.

P. 6034 a. Middle portion of a similar maxilla, with teeth showing the smooth solid apex; Portland Stone, Isle of Portland. *Presented by George Clifton, Esq.*, 1890.

42381. Anterior portion of left maxilla and other fragments; Portland Stone, Isle of Portland. *Purchased*, 1870.

40719. Right maxilla, inner aspect, wanting the hinder portion but with well-preserved remains of teeth showing their characteristic form; Kimmeridge Clay, Dorsetshire. *Purchased*, 1867.

P. 6034. Imperfect right dentary, shown from the outer aspect of one-half the natural size in Pl. VII. fig. 5, remarkable for the crowding of the anterior teeth and the downward curvature of the bone towards the symphysis (*s.*); Portland Stone, Isle of Portland. *Presented by George Clifton, Esq.*, 1890.

Caturus (**Ditaxiodus**) **impar** (Owen).

1866. *Ditaxiodus impar*, R. Owen, Geol. Mag. vol. iii. p. 107, pls. iv. & v.

Type. Jaws; British Museum.

The type species of the so-called genus *Ditaxiodus*, known only by the jaws, which indicate a fish perhaps about 1 metre in length. Maxilla thick but less deepened than in any of the preceding species, much arched throughout the greater part of its length, and the height of the middle teeth considerably exceeding the depth of the bone at their insertion. All the teeth, both upper and lower,

with a very slender incurved apex. Splenial teeth for the most part strongly incurved, and the largest not more than half the size of the principal teeth on the dentary.

Form. & Loc. Kimmeridgian: Oxfordshire.

46318. Type specimen comprising the right maxilla with the imperfect right mandibular ramus and other fragments; Kimmeridge Clay, Culham, Oxfordshire. The small inner row of curved mandibular teeth described by Owen is evidently borne by the splenial bone, which enters and strengthens the mandibular symphysis. *Cunnington Coll.*

46337. Abraded fragment of the anterior end of the right maxilla, doubtfully ascribed to this species; Kimmeridge Clay, Devizes. *Cunnington Coll.*

Caturus (**Strobilodus**) **purbeckensis** (A. S. Woodward).

1890. *Strobilodus purbeckensis*, A. S. Woodward, Proc. Zool. Soc. p. 350, pl. xxix. fig. 4.

Type. Head; British Museum.

Head with opercular apparatus ordinarily measuring about 0·1 in length; external bones without ornament. Maxilla comparatively slender, the oral border slightly convex in its anterior two-thirds, then a little concave, finally turned downwards behind where the teeth are remarkably slender and closely arranged; teeth of middle of maxilla about twice as deep as the bone at their insertion, with much produced slender apical portion. Mandible very slender, pointed but not curved downwards in front; height of middle dentary teeth about equal to depth of bone at their insertion. All the teeth indented at the base on the outer face.

Form. & Loc. Purbeckian: Dorsetshire.

46911. Type specimen described and figured, *loc. cit.*; Swanage. *Purchased*, 1875.

P. 4273. Imperfect right dentary with well-preserved teeth; Swanage. *Enniskillen Coll.*

The following specimens may also be referred to *Caturus* but are not specifically determined:—

P. 3578. Fragmentary remains of a large fish; Lower Lias, Lyme Regis. *Enniskillen Coll.*

P. 530. Imperfect skeleton nearly a metre in length; Upper Lias, Boll, Würtemberg. see p. 343. *Egerton Coll.*

= *C. smithwoodwardi*.

1918. Caturus purbeckensis, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 85, pl. xix. figs. 1, 2.

46911. Des? & fig? A.S.W. 1918, p. 85, pl. xix. fig. 1.
P.6388. Portion of dentary, noticed ibid. p. 86; Swanage.
Beckles Coll.

Holotype ♂. *C. porteri* sp. nov. D.H. Rayner 1948
Ph. Tr. R.S. 233B p. 289 figs. 1-3 pl. 19-20.

P. 902, P. 3730. Three mandibular rami of the form named *Caturus pleiodus* by Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 118, the first described and figured in Proc. Geol. Assoc. vol. xi. (1890), p. 294, pl. iii. fig. 10 ; Stonesfield Slate, Stonesfield.

Egerton & Enniskillen Colls.

P. 4701. Remains of head and abdominal region of a fish resembling *C. furcatus*, but differing from this species in its relatively larger scales ; Lower Kimmeridgian (Lithographic Stone), Cirin, Ain, France. *Purchased*, 1884.

P. 4699. Small immature fish, in counterpart ; Cirin.

Purchased, 1884.

38519. Imperfect remains of fish ; Kimmeridge Clay, Kimmeridge.

Purchased, 1864.

P. 901. Very fragmentary and fragile head and abdominal region : Kimmeridge Clay, Studley, near Trowbridge.

Egerton Coll.

P. 6389. Fragmentary fish ; English Kimmeridge Clay.

Beckles Coll.

40648. Imperfect left maxilla and mandibular ramus of a large fish ; Kimmeridge Clay, Chapman's Pool Bay, Dorsetshire.

Purchased, 1867.

P. 6901. Imperfect head of a large fish, displaying the cranium, right mandibular ramus, and some of the laminar toothed gill-rakers ; Oxford Clay, Peterborough. The dentary exhibits the bases of 24 teeth, and the anterior half of the splenial bears only a single series of small teeth.

Leeds Coll.

29049 a. More imperfect head of a similar fish ; Oxford Clay, Christian Malford, Wiltshire. About 20 branchiostegal rays are shown. *Purchased*, 1854.

29049 b. Imperfect fish about 0·46 in length, with remains of the pectoral, dorsal, and caudal fins : Oxford Clay, Christian Malford. From the characters of the mandible and dentition, this seems to belong to the same species as the last two specimens. *Purchased*, 1854.

P. 4793. Left maxilla of large fish ; Jurassic, Helmsdale, Sutherland.

Presented by Sir Richard Owen, K.C.B., 1884.

P. 442 a. Maxilla described and figured under the provisional name of *C. tenuidens* by the present writer, Geol. Mag. [4] vol. ii. (1895), p. 151, pl. vii. fig. 8; Middle Purbeck, Swanage. *Purchased*, 1882.

P. 6584. More imperfect maxilla; Swanage. *Purchased*, 1891.

36175. Right dentary provisionally named *C. tenuidens*; Swanage. *Purchased*, 1861.

40656–57. Two right dentaries of the same form, the second described and figured *loc. cit.* 1895, p. 151, pl. vii. fig. 7; Swanage. *Purchased*, 1867.

P. 442. Similar left dentary; Swanage. *Purchased*, 1882.

P. 969. Similar right dentary; Swanage. *Egerton Coll.*

P. 6360. Imperfect abraded head, exhibiting relatively large teeth and an especially large gular plate; Wealden, Hastings. *Beckles Coll.*

An imperfect head and pectoral fins of *Caturus* from the Kimmeridge Clay of Cap de la Hève, Havre, have also been described under the name of *Pachycormus insignis*, by H. E. Sauvage, Bull. Soc. Géol. Normandie, vol. xiv. (1892), p. 29, pl. ii. Another imperfect head, apparently of *Caturus*, from the Oxford Clay of Vaches Noires, Normandy (Prevost Collection), is named *Pachycormus macropomus* by Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844) p. 114.

A well-preserved trunk of *Caturus* from the Lias of Walgau, Bavarian Alps, is described under the name of *Lepidotus* (*Semionotus*) *macropterus* by K. E. Schafhäutl, Geogn. Untersuch. sudbäy. Alpengeb. (1851), p. 98, pl. xx. fig. 27. A specifically indeterminable jaw from the Lithographic Stone of Bavaria is named *Caturus branchiostegus* by Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844) p. 118.

Nothing appears to be known of the so-called *Caturus ovatus* (Münster, Neues Jahrb. 1839, p. 679) and *C. brevicostatus* (Münster, *ibid.* 1842, p. 44) from Kelheim.

The portion of dentary from the Chalk of Lewes named *Caturus similis* (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 118, pl. lxvi. *a.* fig. 9) does not belong to this genus, but probably to a Teleostean fish. The original specimen is numbered **4842** and was obtained from the *Mantell Coll.*

Nothing is known of the so-called *Amblysemius gracilis* (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 165) from the Oolite of Northampton, said to be closely related to *Caturus* (*loc. cit.* p. 119). Another species, *A. bellovacinus* or *bellicianus* (V. Thiol-

1918. Caturus semicidens, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 86, pl. xix. figs. 3, 4.

40656. Des? & fig? A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 87, pl. xix. fig. 4.

P. 969. Left maxilla des? & fig? A. S. W. 1918, p. 87, pl. xix. fig. 3.

P. 6360 = type of Caturus (Callopterus?) latidens, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 83, text-fig. 28.

Caturus sp., A. S. Woodward, Proc. Bath Nat. Hist. Antiq. Field Club, vol. viii (1896), p. 235. — U. Lias; Ilminster. [C. Moore Coll., Bath.]

Caturus sp., A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii (1896), p. 155, pl. xix. — U. Lias; Whitby. [York & Whitby Mus.]

"Lias of Walgau" said to be Keuper by P. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, vol. xlii (1901), p. 27.

Caturus deani, W. K. Gregory, Bull. Amer. Mus. N. H. vol. xlviii (1923), p. 227, fig. 3. — Kimmeridgian; Cuba. [Head; A. M. N. H.]

Caturus tarraconensis, H. E. Savage, Mem. R. Acad. Ciencias Barcelona [3] vol. iv. no. 35 (1903), p. 11, pl. iv. fig. 1. — L. Kimmeridgian (Litho. Stone); Montsech, Lérida, Spain. [Imperfect fish;

Syn.
Ainia, D. S. Jordan, Proc. Acad. Nat. Sci. Philad. vol. 70 (1919), p. 344. [illegible]

1949. C. a. P. de Sanz-Secno R. Arch. Mus. H.N. Lyon 2 p. 151 figs. 67-68 pl. xv f. 3.

C. obesus Savage, 1893, Bull. Soc. hist. Nat. Autun 6: 433, pl. 9, fig. 1, fish, Orbagnoux, Ain (Kimm.)

Callopterus insignis, R. H. Traquair, Poiss. Weald. Bernissart (Mém. text-fig. 13. Mus. Roy. Hist. Nat. Belg. vol. V. 1911), p. 34, pl. VI. — Wealden; Bernissart, Belgium. [Imperfect fish; Brussels Mus.]
A.S.W. Pridoux & Rendel, 1918: 82,

Caturus (Callopterus) [illegible] A.S.W. Woodward & Rendel 1918: 83

lière, Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii. 1850, p. 146, and Poiss. Foss. Bugey, pt. ii. 1873, p. 19), from the Lithographic Stone (Lower Kimmeridgian) of Ain, France, is also too imperfectly described for recognition.

Genus **CALLOPTERUS,** Thiollière.

[Bull. Soc. Géol. France, [2] vol. xv. 1858, p. 784, and Poiss. Foss. Bugey, pt. ii. 1873, p. 15.]

A genus apparently differing only from *Caturus* in the more remote situation of the dorsal fin, which is almost completely opposed to the anal. The caudal fin also appears to be less deeply forked.

Callopterus agassizi, Thiollière.

1846. *Lepidotus armatus,* A. Wagner, Gelehrte Anzeig. k. bay. Akad. vol. xxii. p. 303 (inadequate definition).
1858. *Callopterus agassizi,* V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. p. 784.
1863. *Lepidotus armatus,* A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix. p. 620. [Fish ; Palæontological Museum, Munich.]
1873. *Callopterus agassizi,* V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 15, pl. x.
1887. *Callopterus agassizi,* K. A. von Zittel, Handb. Palæont. vol. iii. p. 231, fig. 243.

Type. Fish ; Lyons Museum.

The type species, attaining a length of about 0·45. Length of head with opercular apparatus somewhat exceeding the maximum depth of the trunk and contained about four-and-a-half times in the total length of the fish ; depth of caudal pedicle about two-thirds as great as the maximum depth of the trunk. Mandibular teeth especially stout and closely arranged. Pelvic fins twice as distant from the pectorals as from the anal : dorsal fin, with 16 rays, about half in advance of the anal, which has 10 rays. Ridge-scales of upper caudal lobe much enlarged, extending halfway towards the dorsal fin.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone) : Ain, France.

Not represented in the Collection.

A stouter small fish 0·115 in length, from the Lower Kimmeridgian bituminous limestone of Orbagnoux, Ain, France, has also been referred to this genus under the name of *Callopterus obesus* (H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. 1893, p. 433, pl. ix. fig. 1).

Genus **EURYCORMUS**, Wagner.

[Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 707.]

Syn. *Eurypoma*, T. H. Huxley, Figs. & Descript. Brit. Organic Remains, dec. xii. (Mem. Geol. Surv. 1866), p. 32.

Trunk elongate-fusiform. External head-bones and opercular bones very feebly ornamented with rugæ and tuberculations, all moderately robust: snout obtusely pointed, and maxilla laterally compressed, gradually deepened behind, with a convexly arched dentigerous border; teeth small and arranged in a regular close series on the maxilla and splenial, similarly small and closely arranged on the other inner bones, comparatively large in the single series occupying the anterior half of the dentary bone. Ossifications in the sheath of the notochord well developed, the hypocentra and pleurocentra in part of the caudal region forming completed alternating rings; ossified ribs slender. Fulcra comparatively small on the median fins [unknown on the paired fins]. Pectoral much exceeding the pelvic fins in size, but the latter well developed; dorsal fin small and triangular, opposed to the pelvic pair; anal fin with somewhat extended base; caudal fin deeply forked. Scales delicate, smooth or very finely tuberculated, deeply overlapping, none much deeper than broad, and apparently none with peg-and-socket articulation. Lateral line inconspicuous.

Eurycormus speciosus, Wagner.

1863. *Eurycormus speciosus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 709. pl. iv.

1863. "*Pholidophorus obscurus*, Münster, MS.," A. Wagner, *ibid.* p. 659. [Imperfect axial skeleton: Palæontological Museum, Munich.]

1887. *Eurycormus speciosus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 230, fig. 242.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·35. Length of head with opercular apparatus about equal to the maximum depth of the trunk and occupying somewhat less than one-quarter of the total length of the fish; caudal pedicle less than half as deep as the abdominal region. External bones smooth. Pelvic fins arising far behind the middle point between the pectorals and the anal, opposite the origin of the dorsal, which occupies the middle of the back and comprises about 16 rays; anal fin with about 17 rays, arising immediately behind the termination of the dorsal; length of each lobe of the caudal fin equalling three times the depth of the pedicle at its origin.

1906. Eurycormus speciosus, E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 203, pl. xxviii. figs. 2–4.

1912. Eurycormus speciosus, E. Stromer v. Reichenbach, Lehrb. d. Paläozool. pt. ii. p. 29, fig. 38. [Fish, showing spiral valve in intestine; Paläont. Mus. Munich.]

1963 E.S., O Nybelin, Ark. Zool. 15, figs 13, 14 (text)

A small fish from the Bavarian Lithographic Stone, now in the Dresden Museum, may possibly be an immature example of this species, but is not certainly determinable. It exhibits no ossifications in the notochordal sheath, and is provisionally named *Eurycormus dubius* by B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. (1881), p. 113, pl. ii. fig. 7. Fulcra are observable on the paired fins.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37934. Scattered remains of a fish displaying the typical vertebral axis; Solenhofen. *Häberlein Coll.*

P. 911. A more satisfactorily preserved trunk, labelled *Caturus latissimus* by Münster, apparently showing traces of the ovaries; Kelheim. *Egerton Coll.*

Eurycormus egertoni (Egerton).

1844. *Macropoma egertoni*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 174, 180 (name only).
1858. *Macropoma egertoni*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 10, pl. x.
1859. *Palæoniscus egertoni*, J. Leckenby, Geologist, vol. ii. p. 9.
1866. *Eurypoma egertoni*, T. H. Huxley, Figs. & Descript. Brit. Organic Remains, dec. xii. (Mem. Geol. Surv.), p. 32.
1894. *Eurycormus egertoni*, A. S. Woodward, Geol. Mag. [4] vol. i. p. 214.

Type. Anterior portion of fish; British Museum.

A large species, the head with opercular apparatus in the two only known specimens about 0·18 in length. Cranial roof-bones and parts of the facial bones coarsely rugose, with few tuberculations; maxilla smooth, more than twice as deep behind as in front; opercular bones very feebly rugose and sparsely tuberculated. Scales finely ornamented with minute tubercles and short rugæ, which are closely arranged in antero-posterior series.

Form. & Loc. Kimmeridgian: Speeton, Yorkshire. Oxfordian: Northamptonshire.

P. 569. The type specimen described and figured by Egerton, *loc. cit.*, and further noticed by Huxley and the present writer; in waterworn indurated matrix, described as obtained from "Gault, Speeton," but stated by Leckenby to have been found in the stratum immediately above the clay with *Ammonites biplex*. Much of the fossil is very obscure, and it is only necessary to add to Egerton's description in three particulars. Firstly, it may be

remarked that there is distinct evidence of vertebral ossifications supporting the robust ribs; secondly, the apparently steep frontal profile in advance of the orbit is due partly to fracture and partly to crushing, while distortion is the cause of the great elevation immediately behind the occiput and of the comparatively forward position of the dorsal fin; thirdly, there are conspicuous branchiostegal rays behind the gular plate. *Egerton Coll.*

P. 6912. Imperfect obliquely-crushed head, with some anterior scales, noticed *loc. cit.* 1894; Oxford Clay, Peterborough. Neither ribs nor vertebræ are displayed, though certain feeble indications may denote that some are buried within the specimen; but all the parts exhibited are identical in form, characters, and even in size with the corresponding elements shown in the type specimen. *Leeds Coll.*

Eurycormus grandis, A. S. Woodward.

1889. *Eurycormus grandis*, A. S. Woodward, Geol. Mag. [3] vol. vi. p. 449.

1890. *Eurycormus grandis*, A. S. Woodward, *ibid.* vol. vii. p. 289, pl. x. figs. 1–8.

Type. Imperfect head; Woodwardian Museum, Cambridge.

A large species known only by the head and vertebræ, equalling *E. egertoni* in size. All the external bones smooth or very feebly rugose, those of the cranial roof and some of those of the face ornamented with fine, sparse tuberculations. The squamosal bones appear to be relatively narrower than in *E. egertoni*.

Form. & Loc. Kimmeridgian; Cambridgeshire.

Not represented in the Collection.

The following ring-vertebræ are not certainly determinable, but (as suggested in the Geol. Mag. [4] vol. i. 1894, p. 216) may perhaps pertain to *Eurycormus*:—

P. 6176. Specimen figured in Damon's 'Geol. Weymouth,' ed. 2 (1880), Suppl. pl. xii. fig. 9; Kimmeridge Clay, Weymouth. *Damon Coll.*

41181, 41231, 45926. Nine specimens; Kimmeridge Clay, Weymouth. *Purchased*, 1868, 1874.

41231 a. Imperfect hypocentrum; Kimmeridge Clay, Weymouth. *Purchased*, 1868.

1906. Eurypoma grande, E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 209, pl. xxv. fig. 1, pl. xxxi. figs. 8, 13, 14 [Nuculinge]

Amended definition of Neorhombolepis in A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 87. See also Peltopteryx p. 181.

1909. Neorhombolepis excelsus, A. S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 158, pl. xxxiv. fig. 1.

43077. Desc. & fig. A. S. W. 1909, p. 158, pl. xxxiv. fig. 1.

Genus **NEORHOMBOLEPIS**, A. S. Woodward.

[Proc. Geol. Assoc. vol. x. 1888, p. 304.]

Trunk elongate-fusiform, and head relatively large. External head-bones and the opercular bones robust, more or less ornamented with tubercles and rugæ of enamel; maxilla with a straight dentigerous border, and a long supramaxillary bone; teeth in regular series, large and hollow, nearly as large on some of the inner bones as on the margin of the jaw, but short and tubercular on the entopterygoid; subopereulum at least half as large as the nearly rectangular operculum, and separated from the latter by an almost horizontally-extended suture. Vertebral centra completely ossified, much shorter than deep in the abdominal, more elongated in the caudal region. Pectoral fins relatively large, with an especially robust preaxial ray; [other fins unknown]. Scales thick, with a narrow overlapped border not produced at the angles, and the peg-and-socket articulation feeble or wanting; superficial ganoine nearly smooth; few principal flank-scales as deep as broad, the majority broader than deep, and those of numerous ventral series at least twice as broad as deep.

Neorhombolepis excelsus, A. S. Woodward.

[Plate VIII. fig. 4.]

1888. *Neorhombolepis excelsus*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 304, pl. i. fig. 1.

Type. Imperfect anterior portion of fish; British Museum.

The type species, with head attaining a length of about 0·085. External bones ornamented with closely-arranged elongated tubercles and short rugæ of ganoine; marginal teeth slender, with incurved apex, in a close regular series, and those of the maxilla almost as large as those of the dentary. Preaxial pectoral fin-ray ornamented with elongated tubercles and rugæ of ganoine. Large postclavicular scales ornamented as the head-bones, other scales smooth; scales of the ventral abdominal region very much elongated, often nearly three times as broad as deep, and some with two or three coarse denticulations on the hinder margin.

Form. & Loc. Turonian: Kent.

43077. The type specimen, comprising the imperfect head, abdominal region, and right pectoral fin, shown of the natural size in Pl. VIII. fig. 4; Lower Chalk, Upper Halling, Kent. In the original description of the fossil, only the portion behind the cranium is noticed, the imperfect head

having been subsequently met with in the Collection. Of the cranium, only the highly-ornamented posterior portion of the roof is exposed (fig. 4 *a*), and the parietals (*pa.*) are shown to be very small, the squamosals (*sq.*) extending about twice as far forwards, and the frontals (*fr.*) uniting in a wavy median suture. The smooth hinder margin of the cranial roof must have been deeply overlapped by the large supratemporal plates, of which the outermost is preserved on the left side. The rostral half of the skull is shown in irregular transverse section, and the pterygo-palatine arcade exhibits a large laminar bone, apparently the entopterygoid, covered with closely-arranged tubercular teeth, which become elongated towards the inferior margin and are nearly as large on the ectopterygoid (? or palatine) as on the maxilla. On the right side the greater part of the maxilla (*mx.*), with an elongated supramaxilla (*s.mx.*) on its hinder half, is preserved, showing some traces of ornament and the nearly straight dentigerous border; the mandible is also preserved, but more imperfectly, and tall conical teeth seem to occur on the splenial as viewed in transverse section. Beneath the mandible is part of a large, thin, ornamented plate, evidently the gular. One large cheek-plate (*s.o.*), with sparse radiating ornament, is also shown on the right side. The post-temporal plates are long and narrow, and ornamented in their exposed portion. Two fragments of the operculum (*op.*) on the left side are ornamented, and the subopercular (*s.op.*) on the right side is more than half as deep as the operculum. The last-named and remaining characters are indicated in the published figure and description. *Purchased*, 1871.

Neorhombolepis valdensis, sp. nov.

[Plate VIII. fig. 5.]

Type. Imperfect fish; British Museum.

A species about as large as the type, similarly known only from an imperfect specimen. Principal flank-scales and many of the narrow ventral scales extremely finely pectinated on their hinder margin; vertebral centra in the posterior abdominal region relatively longer than in *N. excelsus*. Other characters, so far as known, as in the latter species.

Form. & Loc. Wealden: Sussex.

1918. *Neorhombolepis valdensis*, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 87, pl. xviii.

P.6364. Des? & fig? A.S.W. 1918, p. 88, pl. xviii.

Neorhombolepis sp.

P.11231. Fragment showing scales & vertebræ, noticed A. S. Woodward, Foss. Fishes English Chalk (Pal. Soc. 1912), p. 256; Lower Cretaceous, 1 kilom. on railway from Santa Amara, Bahia, Brazil. Pres? by Joseph Mawson, Esq., 1913.

P.11232. Scales from same place.
Pres? by Dr. A. S. Woodward, 1913.

1909. Neorhombolepis(?) punctatus, A. S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 160, pl. xxxiv. fig. 2.

P. 6364. The type specimen, a waterworn piece of sandstone with imperfect coiled-up fish; Wealden, Hastings. The fish is partly exposed on both sides of the slab, and portions of its pectoral fin, squamation, and vertebral centra are shown of the natural size in Pl. VIII. figs. 5, 5 *a*, *b*. The head and opercular apparatus are too imperfect for description, but traces of the characteristic external ornament are preserved both on the cranial roof and on the cheek-plates. The middle of the parasphenoid exhibits a cluster of small teeth; and its lateral ascending portion is forked, the anterior limb rising as usual to meet the postfrontal, the posterior limb reaching one of the hinder otic elements. A horizontal (not median) section across one of the short abdominal vertebræ is shown in fig. 5 *a*; and one of the three elongated centra, as exposed in the anterior part of the caudal region, is shown in side view in fig. 5 *b*. The latter are followed by other centra not so much elongated, but still longer than deep. The clavicle and pectoral fin are preserved on the left side, the latter comprising not less than 24 rays, of which each is undivided in its proximal two-thirds but becomes very finely branched and articulated distally. A portion of the largest postclavicular plate on the same side (*p.cl.*) displays the characteristic external ornamentation. The scales are all remarkably smooth, exhibiting no markings beyond feeble, scattered pits; and the serration of their hinder border is extremely fine and inconspicuous. Even the principal flank-scales are broader than deep, while the ventral scales are not only extremely narrowed but also become in part subdivided. *Beckles Coll.*

Neorhombolepis (?) punctatus (A. S. Woodward).

1844. *Lepidotus punctatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 306 (name only).

1844. *Lepidotus punctulatus*, L. Agassiz, *ibid.* pt. ii. p. 287 (name only).

1888. *Genus non det.*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 304, pl. i. fig. 2.

Type. Detached scales; British Museum.

A species known only from detached scales, and doubtfully placed in *Neorhombolepis*. The largest known scale measures 0·015 in breadth, and none are so deep as broad; all specimens exhibit a smooth external layer of ganoine, marked with a few punctations,

and the hinder margin is not serrated. That the scales do not pertain to *Lepidotus* is shown not only by their form, but also by the non-production of the angles of the overlapped anterior border.

Form. & Loc. Turonian: Kent and Surrey.

P. 4705. Group of associated scales, to be regarded as the type specimen; Lower Chalk, Burham, Kent.

Enniskillen Coll.

P. 1106. Two smaller groups of imperfect scales, one labelled by Agassiz; Burham. *Egerton Coll.*

P. 6526. Group of six associated scales, three figured in Proc. Geol. Assoc. vol. x. pl. i. fig. 2; Blue Bell Hill, Burham.

Presented by S. J. Hawkins, Esq., 1891.

P. 7567. Abraded scale; Lower Chalk, Dorking, Surrey.

Purchased.

An imperfect fish much resembling *Neorhombolepis*, but differing in its more powerful dentition and the subdivision of the gular plate into four pieces, is described as follows:—

Otomitla speciosa, J. Felix, Palæontogr. vol. xxxvii. (1891), p. 189, pl. xxix. fig. 3, pl. xxx. figs. 3–5.—Neocomian; Cerro de la Virgen, Tlaxiaco, Oaxaca, Mexico. [Head with scattered scales and vertebræ; J. Felix Collection, Leipzig.]

Genus **LOPHIOSTOMUS**, Egerton.

[Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv. 1852), no. 10.]

An imperfectly known genus with relatively large head, which appears to have been much depressed. External head-bones and the opercular bones robust, more or less ornamented with tubercles and rugæ of enamel; the roof of the cranium raised into a prominent boss on each side immediately behind the orbit; jaws relatively very large, the maxilla with a straight or slightly concave dentigerous border, and the premaxillæ fused with the ethmoid; teeth in regular series, large and hollow on the margin of the jaw, minute on the inner bones, and those of the dentary larger than those of the maxilla; suboperculum nearly half as large as the operculum, which is quadrangular but truncated at the postero-superior angle; gular plate very large. [Axial skeleton of trunk not certainly known.] Fin-rays robust, externally ornamented; paired fins without fulcra, the pelvic pair relatively small; [median

P.4705. Des? A.S.W. 1909, p. 160.

P.6626. Des.d & fig? A.S.W. 1909, p. 160, pl xxxiv. fig. 2.

Examined type of Atomitla, May 9th. 1897. I think cranial roof shows only displaced and broken frontals. Vertebral centra ossified, but apparently not solid. Scales with small peg- and socket. Slender gill-rakers. A.S.W.

P.8636. Two fragments of squamation of Atomitla speciosa; loc. cit. Pres? Dr. J. Felix, 1897.

1909. *Lophiostomus dixoni*, A.S. Woodward, Fos. Fishes English Chalk (Pal. Soc.), p. 155, pl. xxxiii. figs. 4, 5.

23023. Des? & figd. A.S.W. 1909, p. 155, pl. xxxiii. fig. 4.

P. 1116. Scale des? & figd. A.S.W. 1909, p. 157, pl. xxxiii. fig. 5.

P. 4263. Ring-vertebræ noticed A.S.W. 1909, p. 157.

fins unknown]. Scales thick, with a narrow overlapped border not produced at the angles, and the peg-and-socket articulation feeble or wanting; superficial ganoine more or less striated or pitted; numerous series of narrow ventral scales.

One group of remains mentioned below, and another similarly fragmentary group in the Brighton Museum, exhibit ring-vertebræ which probably belong to this fish.

Lophiostomus dixoni, Egerton.

1852. *Lophiostomus dixoni*, Sir P. Egerton, *loc. cit.* no. 10, pls. x., x*.
1888. *Lophiostomus dixoni*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 303.

Type. Head with part of abdominal region; British Museum.

The type species, with head attaining a length of 0·06. External bones and fin-rays ornamented with closely-arranged short rugæ and tubercles of ganoine. Maximum width of cranial roof exceeding two-thirds of its length; the paired frontal prominences narrow and laterally compressed but much elevated, the height of each exceeding half the distance between them. Marginal teeth in one regular series, some exhibiting feeble vertical wrinkles in their apical portion; mandibular ramus about three and a half times as long as its maximum depth. Branchiostegal rays about 12 in number, nearly all ornamented; gular plate as long as the dentigerous portion of the mandible, and at least two-thirds as broad as long. Ornament of fin-rays consisting chiefly of oblique wrinkles. Hinder border of scales with coarse, long, acuminate pectinations, continued on the outer face of the principal scales as oblique wrinkles or elongated pits.

Form. & Loc. Senonian: Sussex and Kent.

23023. The type specimen, described and figured by Egerton, *loc. cit.*; Alfriston, Sussex. The comparatively smooth plate named "scapula," is evidently one of the postclavicular series. *Presented by Capt. J. L. Beckford, R.N.*

P. 1116. Scales and an associated bone-fragment; Alfriston.
Egerton Coll.

P. 5409. Portion of fin-ray and two imperfect scales; Sussex.
Presented by P. E. Coombe, Esq., 1888.

39121. Group of scales and remains of fin-rays; Maidstone.
Bowerbank Coll.

P. 4263. Scales apparently with imperfect ring-vertebræ; Lewes.
Enniskillen Coll.

Lophiostomus affinis, A. S. Woodward.

1895. *Lophiostomus affinis,* A. S. Woodward, Geol. Mag. [4] vol. ii. p. 210, pl. viii. fig. 6.

Type. Hinder portion of cranial roof; British Museum.

A species as large as *L. dixoni,* known only by the hinder portion of the skull, which is somewhat more finely ornamented than in the type species. Frontal prominences slight, not forming a slender eminence.

Form. & Loc. Cenomanian (Cambridge Greensand): Cambridge.

P. 7233. Type specimen described and figured *loc. cit.* *Jesson Coll.*

Family AMIIDÆ.

Trunk elongate or elongate-fusiform, more or less laterally compressed. Cranial and facial bones moderately robust, externally enamelled, and opercular apparatus complete; mandibular suspensorium nearly vertical or inclined backwards, and gape of mouth wide; snout not produced; premaxillæ separate and in contact mesially; marginal teeth mostly stout and conical, inner teeth comparatively small or even minute. Notochord persistent or more or less replaced by vertebræ, which remain as disconnected pleurocentral and hypocentral discs in part of the caudal region. Fin-rays robust, the majority well-spaced, articulated and divided distally; fulcra almost or completely wanting; dorsal and anal fins variable in length. Scales thin and deeply imbricating, more or less rounded in their exposed portion.

The characters of the genus *Liodesmus,* mentioned below, render it difficult to compile a satisfactory diagnosis of this family, which must be regarded as a specialised branch of the Eugnathidæ.

The principal descriptions of the osteology of the type genus, the existing *Amia* of North American lakes and rivers, are the following:—

H. Franque, "Afferuntur nonnulla ad Amiam calvam accuratius cognoscendam" (Inaugural Dissertation: Berlin, 1847).

T. W. Bridge, "The Cranial Osteology of *Amia calva*" (Journ. Anatomy & Physiol. vol. xi. 1877, pp. 605–622, pl. xxiii.).

M. Sagemehl, "Das Cranium von *Amia calva*" (Morphol. Jahrb. vol. ix. 1884, pp. 177–228, pl. x.).

R. W. Shufeldt, "The Osteology of *Amia calva*" (Ann. Rep. U.S. Commiss. Fisheries, 1883 [1885], pp. 747–878, pls. i.–x.).

[illegible] sed. holsteri.

Signeuxella praemonti g-f s.n. Saint-Seine 1955. Ann. Mus.-Congo belge, Sci. geol. 14 p. 75, ff. 61 pl. x f.a. Foss: Mus. Congo. Kinamanda. Congo.

Calcivanotus gen. nov. P. de Saint-Seine 1955, Ann. Mus. Congo belge Sci. geol. 14 p. 18.

C. hornemani s.n. Saint-Seine 1955 p. 18 ff. 5-5 pls iv-vi Foss. Mus. Congo belge. Kinamanda. Congo.

C. passani s.n. (=? Peltopleurus maceni p. 482 1 S. Seine, ibid. 1955. p. 64, ffs. 52-58 pls. vii-viii. do. do.

Lombardina gen. nov. Saint-Seine 1955 ibid. p. 73 s. L. decorata s.n. p. 73 ff. 55-60 pl. ix do. do.

Scales of Amia: K. A. von Zittel, Handb. Palaeont. (18), vol. iii. p. , fig. ; H. Klaatsch, Morphol. Jahrb. vol. xvi (1890), p. ; H. Scupin, Archiv für Naturgeschichte, vol. i (1896), p. 175, pl. x. fig. 12.

Pseudamia heintzi g. et sp. n. Eocene, Cape Heer, Spitzbergen, J. P. Lehman 1951, Tromsø Mus. Årshefter, (1947) 70 no. 2, 11pp. 2 Kartfigs, 3pls. [Fish: Tromsø Mus.].
non Bleeker 1865, Ned. Tijdschs. Dierk 1 p. 290.
Pseudamiatus n. nov. G. P. Whitley, 1954 Australian Zool. 12 p. 57.

Sinamia zhoudanskyi, g. et sp. n. L. Oct. Shanxang China.
E. R. Sténsiö, 1935, Pal. Sinica (C) 3 fasc. 1 48 pp 4 figs. 1, 2, 7, 8, 14-20, 17 pls. [Imp. Fish: ~~Stockholm~~ Pal. Inst: Uppsala].
E. Jarvik 1944, K. Sv. Vet.-Akad., Handl. (3) 21 no. 7, p. 9, 4 figs. 16.

L. Schmidt, "Untersuchungen zur Kenntniss des Wirbelbaues von *Amia calva*" (Zeitschr. f. wiss. Zool. vol. liv. 1892, pp. 748–764, pl. xxxiv.).

Synopsis of Genera.

I. Vertebral elements rudimentary or absent; dorsal fin short-based.	
Trunk elongate, scarcely tapering; fulcra wanting; caudal fin rounded or only slightly forked	*Liodesmus* (p. 361).
II. Vertebral elements forming complete discs; dorsal fin more or less extended.	
Dorsal fin not occupying more than the middle third of the back	*Megalurus* (p. 363).
Dorsal fin occupying more than half the length of the back	*Amia* (p. 367).

Genus **LIODESMUS,** Wagner.

[Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 709.]

Syn. *Lophiurus,* B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, p. 116.

Trunk elongate, scarcely tapering to the caudal pedicle. Head relatively large, with obtuse snout; marginal teeth all large and well-spaced. Notochord persistent, without ossifications in the sheath. Fin-fulcra wanting. Dorsal fin short-based, opposed to the pelvic pair; caudal fin fan-shaped or slightly bifurcated. Scales very small.

Liodesmus gracilis (Agassiz).

1838–44. *Pholidophorus gracilis,* L. Agassiz (*ex* Münster, MS.), Poiss. Foss. vol. ii. pt. i. p. 285, pl. xlii. fig. 2.

1839–44. *Megalurus parvus,* L. Agassiz (*ex* Münster, MS.), *ibid.* vol. ii. pt. ii. p. 149, pl. li. fig. 4. [Nearly complete fish; Palæontological Museum, Munich.]

1851. *Megalurus parvus,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 70.

1851. *Megalurus intermedius,* A. Wagner (*ex* Münster, MS.), *ibid.* p. 71. [Nearly complete fish; Palæontological Museum, Munich.]

1863. *Liodesmus gracilis,* A. Wagner, *ibid.* vol. ix. p. 711.

Type. Vertically crushed fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·06. Head with opercular apparatus occupying somewhat less than one-quarter of

the total length of the fish. Dorsal fin arising at a point half as distant from the occiput as from the upper caudal lobe; caudal fin (according to Wagner) with convex hinder border.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

Not represented in the Collection.

Liodesmus sprattiformis, Wagner.

1863. *Liodesmus sprattiformis*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 713, pl. v. fig. 1.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species attaining a length of about 0·09, similar in proportions to the type, but the caudal fin distinctly cleft; pelvic fins arising immediately behind a point opposite to the origin of the dorsal fin.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37931. Fine nearly complete specimen, in counterpart; Solenhofen. The large, spaced conical teeth are shown in the premaxilla, maxilla, and dentary; and beneath the mandible there are remains both of the gular plate and branchiostegal rays. The neural and hæmal arches are somewhat separated by crushing; but the slender ribs in the abdominal region and the thickened hæmal spines at the base of the tail are distinct. The characters of the median fin-rays are especially well-displayed; and the few short rays at the origin of the dorsal fin are conspicuous. The squamation is scarcely displaced in any part, but it is difficult to determine the precise form and proportions of the deeply overlapping scales.

Häberlein Coll.

P. 912. Specimen with more imperfectly preserved scales and caudal fin, and wanting the anterior half of the head; Solenhofen. The axial skeleton of the trunk, the pelvic fin-supports, and the impression of hard coprolitic matter in the intestinal tract, are noteworthy features.

Egerton Coll.

P. 3659. Imperfect fish, partly dorsal and partly lateral aspect; Kelheim. *Enniskillen Coll.*

An imperfect small fish in the Dresden Museum, from the Lithographic Stone of Bavaria, described under the name of *Lophiurus*

= Vidalenia W.-Th.T. (1946) a.-M.-N.-H. (11) 7 p. 400.

Genus Vidalia, Sauvage.

[Mem. R. Acad. Ciencias Barcelona (3) vol. iv. no. 35, 1903, p. 15.]

Vidalia catalunica, Sauvage.

1903. Vidalia catalunica, H. E. Sauvage, loc. cit. p. 15, pl. i. fig. 4; pl. iv. fig. 3.

1950. V. c., J. R. Batalla, Bol. Inst. Esp. Esp. 67: 14 pl. xiv f. 2.

Syn. Urocles, D. S. Jordan, Proc. Acad. Nat. Sci. Philad. vol. 70 (1919), p. 343.

Synergus, J. Gistel, Naturgesch. Thierreichs, 1848, p. ix [Name only, Megalurus said to be preoccupied, Horsf. 1832].
Non Synergus Hartig 1840 in German, Z. Entom. 2 (1), 186 (Hym.).

Skuhravá, Rayner 1981, Bull. Br. Mus. 16 p. 222 ff.

3a.

1914. Megalurus lepidotus, C. R. Eastman, Mem. Carnegie Mus. vol. VI. p. 412, pl. 7xx. fig. 3.

minutus by B. Vetter (Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, p. 116, pl. ii. fig. 16), also seems to be referable to the genus *Liodesmus*.

Genus **MEGALURUS,** Agassiz.

[Poiss. Foss. vol. ii. pt. i. 1833, p. 13.]

Trunk elongate, much laterally compressed. Head large; all the marginal teeth large and conical, but those of the dentary largest; inner teeth minute; maxilla laterally compressed and much deepened behind; gular plate present. Vertebral centra completely ossified in the adult, biconcave, the hypocentra and pleurocentra forming distinct alternating discs in part of the caudal region; ribs short and delicate. Fin-fulcra wanting.[1] Dorsal fin somewhat extended, but not occupying more than the middle third of the back; anal fin small and short-based; caudal fin with convex hinder border. Scales almost oval in shape, the long axis horizontal.

Megalurus lepidotus, Agassiz.

1833–44. *Megalurus lepidotus,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 13; pt. ii. p. 146, pl. li. *a*.
1839–44. *Megalurus brevicostatus,* L. Agassiz, *ibid.* pt. ii. p. 147, pl. li. fig. 3. [Imperfect fish; Palæontological Museum, Munich.]
1851. *Megalurus lepidotus,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 69.
1851. *Megalurus brevicostatus,* A. Wagner, *ibid.* vol. vi. p. 70.
1863. *Megalurus lepidotus,* A. Wagner, *ibid.* vol. ix. p. 714.
1863. *Megalurus brevicostatus,* A. Wagner, *ibid.* vol. ix. p. 719.
1881. *Megalurus brevicostatus,* B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 116.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·4. Head with opercular apparatus occupying nearly one-quarter of the total length of the fish, and the depth of the caudal pedicle contained much less than five times in the length from the hinder border of the operculum to the base of the middle caudal fin-rays. Vertebræ about 45 in number, all much deeper than broad, smooth and not indented laterally. Dorsal fin comprising about 20 rays, the distance between its origin and the post-temporal bones about equal to that between

[1] Wagner (Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 717) describes "feinen, börstenartigen Stacheln (fulcra)" on the pelvic fins of the so-called *M. altivelis*.

its hinder extremity and the end of the upper caudal lobe; pelvic fins arising opposite the origin of the dorsal, and the anal fin comprising about 9 rays, opposed to the hinder portion of the latter.

It is not improbable that the skull from the Lithographic Stone of Nusplingen, Würtemberg, described under the name of *Strobilodus suevicus* (F. A. Quenstedt, Der Jura, 1858, p. 809, pl. c. fig. 10), also pertains to this species. The type specimen is preserved in the University Museum, Tübingen, Würtemberg.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37366. Plaster cast of type specimen; Solenhofen.

Purchased, 1863.

P. 952. Fish 0·155 in length, well preserved but chiefly as an impression; probably from Solenhofen. Nineteen supports are distinctly shown in the dorsal, and nine in the anal fin. *Egerton Coll.*

P. 953. Immature fish wanting the head and the greater part of the fins: Kelheim. *Egerton Coll.*

Megalurus elongatus, Agassiz.

1839–44. *Megalurus elongatus*, L. Agassiz (*ex* Münster, MS.), Poiss. Foss. vol. ii. pt. ii. p. 148, pl. li. figs. 1, 2.

1851. *Megalurus elongatus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. vi. p. 70.

1851. *Megalurus polyspondylus*, A. Wagner (*ex* Münster, MS.), *ibid.* vol. vi. p. 71. [Nearly complete fish; Palæontological Museum, Munich.]

1863. *Megalurus grandis*, A. Wagner, *ibid.* vol. ix. p. 714. [Ditto.]

1863. *Megalurus polyspondylus*, A. Wagner, *ibid.* vol. ix. p. 718.

1863. *Megalurus elongatus*, A. Wagner, *ibid.* vol. ix. p. 719.

1873. *Megalurus polyspondylus*?, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 22, pl. viii. fig. 1.

1881. *Megalurus polyspondylus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 116.

1887. *Megalurus polyspondylus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 234, fig. 247.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species attaining a length of about 0·45. Head with opercular apparatus occupying not more than one-fifth of the total length of the fish, and the depth of the caudal pedicle contained more than five times in the length from the hinder border of the operculum to the base of the middle caudal fin-rays. Vertebræ about 60 in

1949. Urocles ~~magalurus~~ elongatus P. de St Scenis, N. Arch. Mus. H. N. Lyon t. VI p. 170 fig. 75-77, pl. xvii f. A.

1911. Megalurus elegantissimus, O. Jaekel, Die Wirbeltiere, p. 85, fig. 94.

1914. Megalurus elegantissimus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 412, pl. lxx. fig. 2.

Megalurus mawsoni, A. S. Woodward.

1902. Megalurus mawsoni, A. S. Woodward, Ann. Mg. Nat. Hist. [7] vol. ix. p. 87, pl. ii.

Type. — Fish wanting head; British Museum.

number, some nearly as deep as broad, all smooth and not indented laterally. Fins as in the type species except that the dorsal, pelvic, and anal are placed slightly further forwards.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria, and Ain, France.

49140. Plaster cast of type specimen of the so-called *M. grandis*; Eichstädt, Bavaria. *Purchased*, 1878.

P. 5545. A fine, equally large specimen; Eichstädt. The caudal vertebræ exhibit a feeble longitudinal keel on the middle of each centrum; and a regular series of twelve branchiostegal rays is displayed on the right side of the fish. *Purchased*, 1888.

22510. Caudal pedicle and fin of an equally large fish; Solenhofen, Bavaria. *Purchased*, 1848.

P. 3658. Fish 0·23 in length, somewhat fractured but displaying all the characters of the species; Kelheim, Bavaria. The caudal vertebræ scarcely show the lateral keel noted in a previous specimen. Twenty-two supports are exhibited in the dorsal, and eight in the anal fin. *Enniskillen Coll.*

49133. Plaster cast of specimen of the so-called *M. polyspondylus* described by Wagner, *loc. cit.* 1863; Eichstädt. *Purchased*, 1878.

Megalurus elegantissimus, Wagner.

1863. *Megalurus elegantissimus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 720, pl. v. fig. 2.

Type. Nearly complete fish; Palæontological Museum, Munich.

A small species attaining a length of about 0·15, apparently only distinguished from *M. elongatus* in the somewhat more slender proportions both of the head and trunk.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37368. Plaster cast of type specimen; Solenhofen. *Purchased*, 1863.

37102. A larger specimen 0·145 in length, showing all the fins and displaying the vertebral column in the caudal region; Solenhofen. Twenty-two supports are observable in the dorsal, and seven in the anal fin. *Häberlein Coll.*

Megalurus damoni, Egerton.

1858. *Megalurus damoni*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 8, pl. viii.

1873. *Megalurus damoni*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 22, pl. ix. = *Amiopsis* sp. Pict. Sacc.-Swiss 1949. N. Arch. Mus. H.N. Lyon 3 p. 182.]

Type. Imperfect fishes; British Museum.

A species attaining a length of about 0·3. Head with opercular apparatus occupying about one-fifth of the total length of the fish, and the depth of the caudal pedicle contained scarcely five times in the length from the hinder border of the operculum to the base of the middle caudal fin-rays. External bones slightly rugose, otherwise not ornamented. Vertebræ not exceeding 50 in number, each with an upper and lower deep lateral indent. Fins as in the type species. Scales apparently all much broader than deep.

Form. & Loc. Purbeckian: Dorsetshire. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 563, P. 3660. The two type specimens; Bincombe, near Weymouth. *Enniskillen & Egerton Colls.*

41156. Fine specimen 0·195 in length; Isle of Portland. The caudal region is fractured and thus in part somewhat obscured, but there cannot have been many alternating hypocentra and pleurocentra. *Purchased*, 1868.

P. 3661. Smaller, more imperfect fish apparently showing more numerous alternating hypocentra and pleurocentra in the caudal region; near Weymouth. *Enniskillen Coll.*

41171. Two halves of a large fish on the alternate halves of counterpart slabs; Isle of Portland. *Purchased*, 1868.

Megalurus austeni, Egerton.

1858. *Megalurus austeni*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 9, pl. ix.

1858. *Attakeopsis* (?) *austeni*, V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. p. 785.

Type. Imperfect head and abdominal region; British Museum.

An imperfectly known and indefinable species closely resembling *M. damoni*, having similar vertebræ but apparently differing in the relatively much greater depth of the scales in the abdominal region.

Form. & Loc. Purbeckian: Dorsetshire.[1]

[1] The species is supposed by Thiollière (*loc. cit.*) to occur also in the Lithographic Stone of Cirin, France.

Amiopsis, Kner.

[SB. k. Akad. Wiss. Wien, math.-naturw. Cl. vol. xlviii. pt. i. 1863, p. 126.]

1918. Amiopsis damoni, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 91, pl. xix. figs. 5, 6.

P. 563. Scales des? & fig? A.S.W. 1918, p. 92, pl xix. fig. 6.

41156. Des? & fig? A.S.W. 1918, p. 91, pl xix. fig. 5.

41171. Circumorbitals and operculum noticed by A.S.W. 1918, pp. 91, 92.

1918. Amiopsis austeni, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 94, text-fig. 31.

Amiopsis (?) dartoni, C. R. Eastman, Bull Geol. Soc. America, vol. x (1899), p. 406, pl. xlviii. figs. 1, 2. — Jurassic; Black Hills, S. Dakota [Fragments]

P. 8376-77. Jaws of Amiopsis sp., a maxilla & a dentary des? & fig? A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 94, pl. xix. figs. 7, 8; Purbeckian, Portland. By exchange.

Amiopsis dolloi, R. H. Traquair, Poiss. Weald. Berniszart (Mém. Mus. Roy. Hist. Nat. Belg. vol. v. 1911), p. 37, pl. vii. text-figs. 14-18. — Wealden; Berniszart, Belgium. [Imperfect fish; Mus. Brussels.]

Amiopsis lata, R. H. Traquair, loc. cit. 1911, p. 42, pl. viii. — Ibid. [Ditto.]

Megalurus sauvagei, L. M. Vidal, Bol. Instit. Geol. España, vol. (1915), p. 28, text-fig. 7. — L. Kimmeridgian (Litho. Stone); Montsech, Lérida, Spain.

Megalurus woodwardi, H. E. Sauvage, Mem. R. Acad. Ciencias Barcelona [3] vol. iv. no. 35 (1903), p. 12, pl. iv. fig. 2. — Ibid. [Imperfect fish;

Amia remains from Tertiary Zaïssan, Semipalatinsk Russia, A. Stoyanow Bull. Com. geol. Pétrogr. xxxiv (1915) p. 487 pls. xv-xvii.

Amia - copous Buckland 1829. Tr. G. Soc. Lon [2] iii, 234.

Amia (?) sp Oligoc. S. W. Montana, H. F. Becker 1960 Mem. G. Soc. America 82:38 pl. 32

P. 564. Type specimen, evidently owing the relatively great depth of the abdominal region to distortion; Swanage. Some of the scales are well preserved in the dorsal part of the abdominal region. *Egerton Coll.*

The following species have also been named and inadequately defined, but there are no examples in the Collection:—

Megalurus altivelis, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1863), p. 716.—Lower Kimmeridgian (Lithographic Stone); Bavaria. [Imperfect skeleton; Palæontological Museum, Munich.]

Megalurus idanicus, V. Thiollière, Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii. (1850), p. 158, and Poiss. Foss. Bugey, pt. ii. (1873), p. 22.—Lower Kimmeridgian (Lithographic Stone); Cirin, Ain, France. [Imperfect fish; Lyons Museum.]

Genus **AMIA**, Linnæus.

[Syst. Nat. ed. 12, 1766, p. 500.]

Syn. *Cyclurus*, L. Agassiz, Poiss. Foss. vol. v. pt. i. 1844, p. 12.
Notæus, L. Agassiz, *ibid.* 1844, p. 15.

Trunk elongate and laterally compressed. Head large; supramaxillary bone relatively large; maxilla, premaxilla, palatine, and dentary with a single series of large conical teeth; the complex splenial and other inner elements with minute teeth; gular plate present. Vertebral centra completely ossified in the adult, short and biconcave, the hypocentra and pleurocentra forming distinct alternating discs in part of the caudal region; each neural arch articulating with two centra, and the abdominal vertebræ with prominent transverse processes; ribs at least as long as the neural arches in the abdominal region. Fin-fulcra wanting. Dorsal fin much extended, occupying more than half the length of the back; anal fin small and short-based; caudal fin with convex hinder border.

Amia valenciennesi (Agassiz).

1839–44. *Cyclurus valenciennesii*, L. Agassiz, Poiss. Foss. vol. v. pt. i. p. 12; pt. ii. p. 44, pl. liii. figs. 2, 3.

1851. *Amia*, J. J. Heckel, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. vi. p. 223.

1858. *Notæus laticaudus*, M. de Serres (*errore*), Comptes Rendus, vol. xlvi. p. 751.

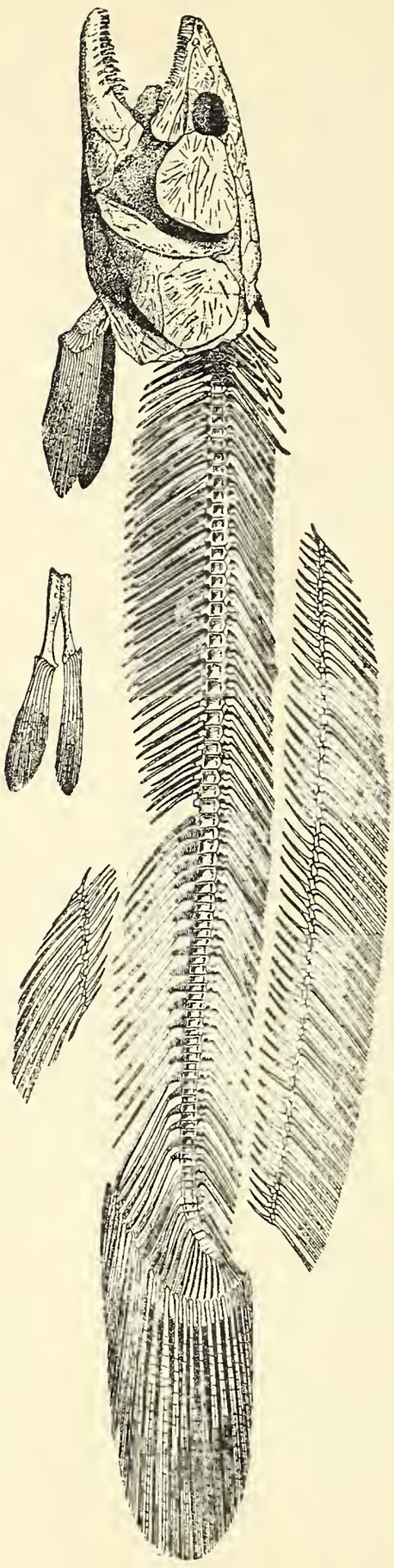


Fig. 37.

Amia calva; skeleton of recent fish (after Franque).

Amia anglica, E. T. Newton.

1899. Amia anglica, Q.J.G.S., LV, p. 3, pl. i figs. 1-21. - Bembridge Marl; Hamstead, I.W. [Portions of jaws, vertebrae &c. M.P.G.]. Also Osborne Beds, Kings Quay I.W.

1937. Protamia anglica, C. Deschamps, p. 14.

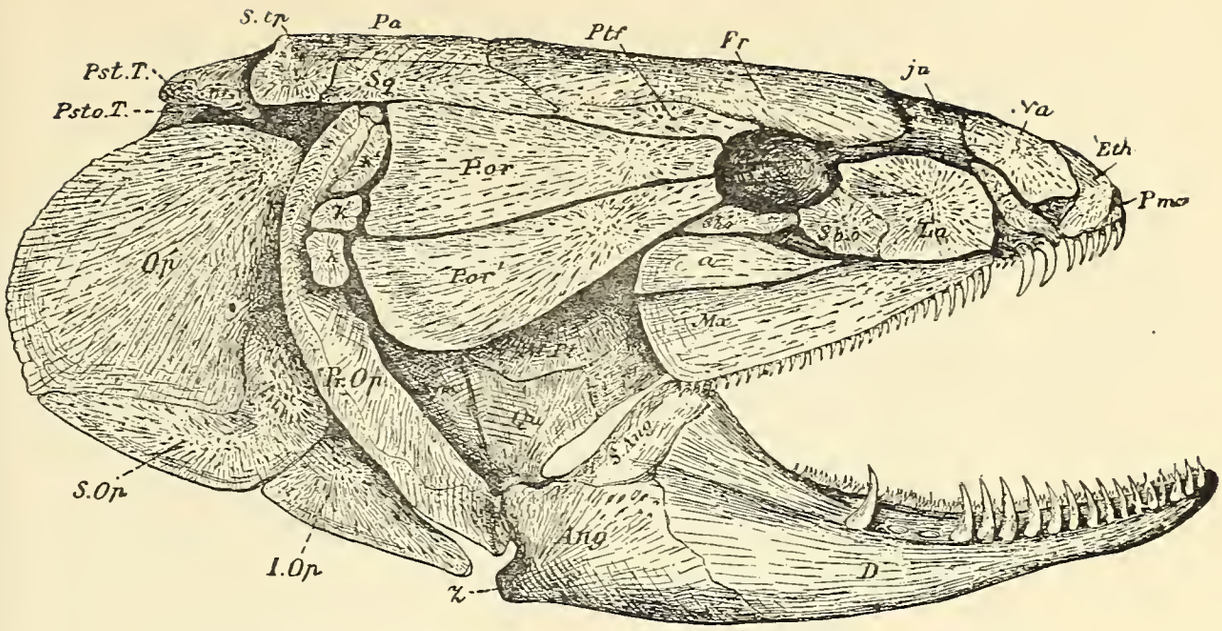
Amia colenutti, E. T. Newton.

1899. A. colenutti, Q.J.G.S. LV. p. 8. pl. i f. 22. Osborne Beds, Kings Quay I.W. [Maxilla; M.P.G.].

1937. Protamia colenutti, C. Deschamps, p. 14.

C. T. Regan, Proc. Zool. Soc. 1923, p. 451, with figs.

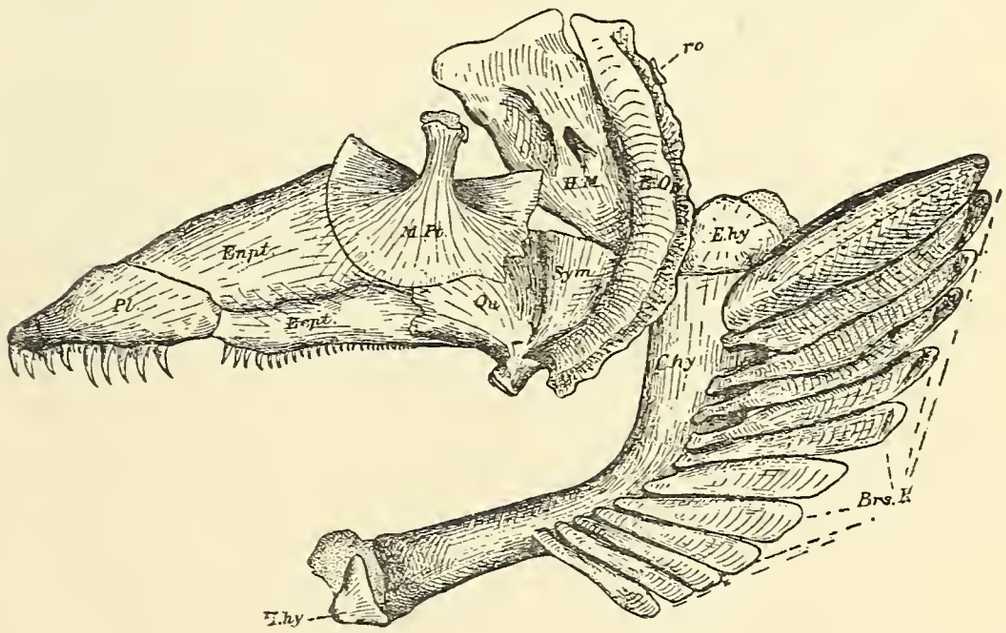
Fig. 38.



Amia calva; head and opercular apparatus (after Shufeldt).

a, supramaxillary; *Ang.*, angular; *D.*, dentary; *Eth.*, ethmoid; *Fr.*, frontal; *I.Op.*, interoperculum; *jn.*, membranous tract between frontals and nasals; *k.*, supplementary dermal bones; *La.*, anterior suborbital (lachrymal); *M.Pt.*, metapterygoid; *Mx.*, maxilla; *Na.*, nasal; *Op.*, operculum; *P.or.*, posterior suborbital; *Pa.*, parietal; *Pmx.*, premaxilla; *Pr.Op.*, preoperculum; *Pst.T.*, post-temporal; *Psto T.*, supraclavicle ("posterotemporal"); *Ptf.*, postfrontal; *Qu.*, quadrate; *S.Ang.*, surangular (coronoid); *S.Op.*, subopercular; *S.tp.*, supratemporal; *Sb.o.*, suborbital; *Sq.*, squamosal; *Sym.*, symplectic; *z*, ossification of Meckel's cartilage.

Fig. 39.



Amia calva; left pterygo-palatine arcade, etc. (after Shufeldt).

Brs.R., branchiostegal rays; *C.hy.*, ceratohyal; *E.hy.*, epihyal; *Ecpt.*, ectopterygoid; *Enpt.*, entopterygoid; *H.hy.*, hypohyal; *H.M.*, hyomandibular *M.Pt.*, metapterygoid; *Pl.*, palatine; *Pr.Op.*, preoperculum; *Qu.*, quadrate; *ro.*, articular facette for operculum; *Sym.*, symplectic.

1867. *Cyclurus valenciennesii*, P. Gervais, Zool. et Pal. Gén. p. 198, pl. xli. figs. 2, 3.

1874. *Cyclurus valenciennesi*, H. E. Sauvage, Bull. Soc. Hist. Nat. Toulouse, vol. viii. p. 181, pl. i. fig. 1.

Type. Fish wanting anterior abdominal region; British Museum.

The type species of the so-called genus *Cyclurus*, attaining a length of about 0·45. Length of head with opercular apparatus greater than the distance between the paired fins and contained about four times in the total length of the fish; maximum depth of trunk contained somewhat more than five times in the total length. Ribs longer than the neural arches. Anal fin with 12 rays.

Form. & Loc. Lower Miocene: France.

M. Eocene acc. to Pictet

P. 446. Type specimen, being the much-fractured hinder two-thirds of a fish; in Lignite, Ménat, Puy-de-Dôme.

Egerton Coll.

27736. Three fragments of smaller fishes, one displaying the long rays of the pelvic and anal fins; Ménat. *Croizet Coll.*

Amia macrocephala (Reuss).

1844. *Cyclurus macrocephalus*, A. E. Reuss, Geogn. Skizzen aus Böhmen, vol. ii. p. 267.

1848. *Cyclurus macrocephalus*, H. von Meyer, Neues Jahrb. p. 430.

1851. *Cyclurus macrocephalus*, H. von Meyer, Palæontogr. vol. ii. p. 61, pl. viii. figs. 5, 6, pl. ix. figs. 1–3.

1851. *Amia*, J. J. Heckel, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. vi. p. 223.

Type. Imperfect fishes; Royal Bohemian Museum, Prague.

A small species attaining a length of about 0·25. Length of head with opercular apparatus much greater than the distance between the paired fins and contained three-and-a-half times in the total length of the fish; maximum depth of trunk contained somewhat more than five times in the total length. Ribs not longer than the neural arches. Anal fin with 10–12 rays, dorsal fin with about 35 rays. Scales radiately striated.

Form. & Loc. Lower Miocene: Kutschlin, Bohemia.

Not represented in the Collection.

Amia ignota, Blainville.

1807. Description by B. G. de Lacépède, Ann. Muséum, vol. x. p. 234.

1818. *Amia ignota*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 373.

1822. "*Amia à deux nageoires*," G. Cuvier, Oss. Foss. new ed. vol. iii. p. 342, pl. lxxvi. fig. 13.

1914. Amia (Cyclurus) valenciennesi, F. Priem, Mém. Soc. Géol. France, vol. xxi, Mém. no. 50, p. 1, pl. iii. fig. 3.

1937. Amia valenciennesi, L. Piton 1937° p. 24, fig. 10 (restored head).

1940. A. v. L. Piton° p 260, Pl. xxi f. 1.

1900. Amia ignota, F. Priem, Bull. Soc Géol. France
[3] vol. xxviii. p. 842, pl. xv. fig. 1.

Thecachoania orientalis g. et sp. nov. H. Tchihatchef
Palaeontologia 2 : 125 2 pls. L. Oeta. Inner Mongolia.

1844. *Notæus laticaudus*, L. Agassiz, Poiss. Foss. vol. v. pt. i. p. 15; pt. ii. p. 127, pl. xlvi.

1851. *Amia*, J. J. Heckel, Sitzungsb. k. Akad. Wiss., math.-phys. Cl. vol. vi. p. 223.

1893. *Amia laticaudata*, A. Andreae, Verhandl. naturh. Vereins Heidelberg, n. s. vol. v. p. 12.

Type. Nearly complete fish; Paris Museum of Natural History.

The type species of the so-called genus *Notæus*, attaining a length of about 0·25. Length of head with opercular apparatus much greater than the distance between the paired fins, about equal to the maximum depth of the trunk, and contained somewhat more than four times in the total length of the fish. Ribs longer than the neural arches. Dorsal fin-rays not less than 40 in number.

Form. & Loc. Upper Eocene (Gypsum): Montmartre, Paris.

Not represented in the Collection.

The following specimens represent an undetermined species as large as *A. valenciennesi*, differing from this apparently in the more slender proportions of the trunk :—

44098. Fish in side view wanting the caudal fin, preserved in the two halves of a much-pyritized nodule; supposed to have been obtained from the Miocene of France.

Purchased, 1873.

44638. Anterior half of fish, vertically crushed, in a similar nodule, much pyritized; entered in the Register as from "Auvergne." *Presented by Henry Ludlam, Esq.*, 1873.

The following vertebræ of *Amia* are also not specifically determined :—

P. 6477. Two large vertebral centra, probably from the Upper Eocene of the Hampshire Basin. *Beckles Coll.*

P. 1532 x. Another large vertebral centrum, much broader than deep; Upper Eocene, Hordwell, Hampshire. *Egerton Coll.*

P. 1532 y, z. Smaller centra; Hordwell. *Egerton Coll.*

The imperfect fish described as follows, exhibits no characters by which it can be distinguished from *Amia* :—

Amiopsis prisca, R. Kner, Sitzungsb. k. bay. Akad. Wiss., math.-phys. Cl. vol. xlviii. pt. i. (1863), p. 126, pl. i.—Upper Cretaceous (Turonian); Isonzothal, Istria. [Fish wanting dorsal, pelvic, and anal fins.]

The following species apparently of the genus *Amia* have also been described upon the evidence of fragmentary specimens:—

Amia depressa, O. C. Marsh, Proc. Acad. Nat. Sci. Philad. 1871, p. 105.—Eocene; Wyoming. [Vertebræ; Yale College Museum.]

Amia dictyocephala, E. D. Cope, Bull. U.S. Geol. Surv. Territ. vol. i. ser. 2 (1875), p. 3.—Eocene; South Park, Colorado. [Imperfect fish.]

Amia kehreri, A. Andreae, Verhandl. naturh. Vereins Heidelberg, n. s. vol. v. (1893), p. 9, and Abh. Senckenb. naturf. Ges. vol. xviii. (1894), p. 359, pl. i. figs. 8–23.—Lower Miocene; Messel, Darmstadt. [Fragments; Andreae Collection.]

Amia longistriata, A. Andreae, *loc. cit.* (1894), p. 362. *Notæus longistriatus*, T. C. Winkler, Archives Mus. Teyler, vol. v. (1880), p. 101, pl. iv. fig. 13.—Middle Oligocene (Lignite); Sieblos, Rhenish Prussia. [Imperfect fish; University Geological Museum, Würzburg.]

Amia macrospondyla, E. D. Cope, Contrib. Canadian Palæont. (Geol. Surv. Canada), vol. iii. (1891), p. 2, pl. i. fig. 2.—Lower Miocene; Cypress Hills, N.W. Territory, Canada. [Anterior vertebral centrum; Canadian Geol. Surv. Museum, Ottawa.]

Amia newberriana, O. C. Marsh, Proc. Acad. Nat. Sci. Philad. 1871, p. 105.—Eocene; Wyoming. [Vertebræ; Yale College Museum.]

Amia oligocenica, A. Andreae, *loc. cit.* (1894), p. 362. *Cyclurus oligocenicus*, T. C. Winkler, *loc. cit.* (1880), p. 99, pl. iv. figs. 11, 12.—Middle Oligocene (Lignite); Sieblos, Rhenish Prussia. [Imperfect caudal region; University Geological Museum, Würzburg.]

Amia scutata, E. D. Cope, *loc. cit.* (1875), p. 3.—Eocene; South Park, Colorado. [Caudal region of fish.]

Amia whiteavesiana, E. D. Cope, *loc. cit.* (1891), p. 2, pl. i. fig. 1.—Lower Miocene; Cypress Hills, N.W. Territory, Canada. [Anterior vertebral centrum; Canadian Geol. Surv. Museum, Ottawa.]

The so-called *Cyclurus minor* (L. Agassiz, Poiss. Foss. vol. v. 1839–44, pt. i. p. 12; pt. ii. p. 45, pl. liii. fig. 1) from the Miocene of Oeningen, Switzerland, and *Notæus agassizi* (G. von Münster, Beitr. Petrefakt. pt. vii. 1846, p. 27, pl. iii. fig. 2) from the

Amia dictyocephala, L. Hussakof, Bull. Amer. Mus. N. H. vol. xxv (1908), p. 60, figs. 29.

Amia exilis, L. M. Lambe, Contrib. Canad. Palæon. vol. iii, pt. iv (1908), p. 12, pl. i, figs. 1-6. — Cypress Hills, Saskatchewan. [Vertebræ; Canadian Geol. Surv., Ottawa.]

Amia lemoinei, M. Leriche, Ann. Soc. Géol. Nord, vol xxix. (1901), p. 183, text-fig. 2. — L. Eocene; Cuis, Marne. [Caudal vertebra; Univ. Lille

Amia: Notæus megacephalus, C. G. Giebel, Zeitschr. gesammt. Naturw. vol. 33 (1869), p. 511.

Amia munieri, F. Priem, Ann. Paléont. vol. vi (1911), p. 34, pl. iv. figs. 6-13, pl. v. figs. 3-13, text-fig. 40-42. — H. Sannoisian; Romainville, Seine. [Head, &c.; Geol. Mus. Sorbonne.] C. Dechaseaux 1937, Ann. Pal. xxvi. p. i. ff. 2, 5. p

Amia morini, F. Priem, Ann. Paléont. vol. vi (1911), pl. iv. fig. p. 33, text-fig. 39. — H. Sannoisian; Romainville, Seine. [Vertebra; Geol. Mus., Sorbonne.]

Amia robusta, F. Priem, Bull. Soc. Géol. France [4] vol. i (1901), p. 485, pl. x. figs. 1-13, text-figs. 1-3. — Landenian Cernay, Marne, France. A. (cf.) r. E. I. White, 1931, Vert. Faunas English Eocene I, p. 77, ff. 121-123. (B. B. AW.).

Jaws and vertebrae of Amia from Paleocene of Prov. Semipalatinsk, W. Siberia, desc: by A. Stoyanow, Bull. Com. Géol. Petrograd, vol. xxxiv (1915), pp. 487-508, pls. xv-xvii.

L.S. Russell, Same in part, Am. J. Sci. April 1929 vol. XVII, p. 369 + A.J.S. March 1928 vol. XV p. 264

Stylomylerdon lacus, G. rs. n. L.S. Russell, 1928, Amer. Journ. Sci. (5) XV p. 203, 4 figs. -- U. Cret. - Paleocene, Alberta. Teeth & other frags Amiid in Nat. Mus. Univ. Alberta

Amia fragosa; Kindleria fragosa, n.s. D.S. Jordan, Canad. Field-Nat. XLI, Oct. 1927, pp. 145-7, 14 figs. U. Cretac? Alberta, (Maxill. G. Surv. Canada.). D.S. Jordan, 1928, Science, N.Y. LXIX. p. 271. + C.F.N. XLII. 1928 p. 42.

Paramiatus gurleyi, n.g. n.s., A.S. Romer + F.M. Fryxell, 1928, Amer. Journ. Sci. XVI. No 96 (Dec.) p.p. 518-527, 3 figs. - Eocene (Green River Shales) Wyoming. [Almost complete fish; Walker Mus., ? Chicago). A deep-bodied form typically Amiid.

Pappichthys patagonica, F. Ameghino, Anales Mus. Nac. Buenos Aires, vol. xv (1906), p. 183, pl. ii. fig. 2 - Patagonian; Argentina. [Indeterminable fragment of jaw.]

Pappichthys barroisi, C.H. M. Leriche, Ann. Soc. Géol. Nord, vol. xxix. (1901), p. 185, pl. ii. fig. 1, 3-16, text-fig. 3. - L. Eocene; Cuis, Marne. [Fragments of skull; Univ. Lille.]

Amia (Pappichthys) barroisi, F. Priem, Bull. Soc. Géol. France [4] vol. i (1901), p. 488, pl. x. figs. 14-16; M. Leriche, Mém. Soc. Géol. Nord, vol. v (1906), p. 352. ? includes jaw of Lacerta? eocenea, Owen, from L. Eocene, Kyson (M. Leriche, Ann. Soc. Géol. Nord, vol. xxxvi. 1907, p. 167).

Vertebra of Amia (Bartonian, Auvers, Oise), F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont. 1908), p. 123, text-fig. 62.

Tertiary of Vienna, are not Amioids. The type specimen of the first is in the British Museum Collection (no. P. 3871).

Cyclurus siculus (O. G. Costa, Ittiol. Foss. Ital. 1860, p. 36, pl. iii. fig. 9), from a Tertiary stratum between Caltagirone and Girgenti, Sicily, is indeterminable.

Fragmentary remains of large fishes, closely related to *Amia* and not yet clearly distinguished, are described from the Lower Tertiary of North America under the generic names of *Protamia* and *Hypamia* (J. Leidy, Proc. Acad. Nat. Sci. Philad. 1873, p. 98) and *Pappichthys* (E. D. Cope, Ann. Rep. U.S. Geol. Surv. Territ. 1872 [1873], p. 634). The following species are named:—

Amia (*Protamia*) *gracilis*, J. Leidy, Proc. Acad. Nat. Sci. Philad. 1873, p. 98, and Contrib. Extinct Vert. Fauna W. Territ. (Rep. U.S. Geol. Surv. Territ. vol. i. 1873), p. 188, pl. xxxii. figs. 23, 24.—Bridger Eocene; Wyoming. [Vertebral centrum.]

Amia (*Protamia*) *media*, J. Leidy, *ibid.* p. 98, and *ibid.* p. 188, pl. xxxii. figs. 7–11.—Ibid. [Vertebral centra.]

Amia (*Protamia*) *uintaensis*, J. Leidy, *ibid.* p. 98, and *ibid.* p. 185, pl. xxxii. figs. 1–6.—Ibid. [Vertebral centra and basi-occipital.]

Hypamia elegans, J. Leidy, *ibid.* p. 98, and *ibid.* p. 189, pl. xxxii. figs. 19–22.—Ibid. [Vertebral centrum.]

Pappichthys corsoni, E. D. Cope, Ann. Rep. U.S. Geol. Surv. Territ. 1872 (1873), p. 636, and Vert. Tert. Form. West, Book I. (Rep. U.S. Geol. Surv. Territ. vol. iii. 1884), p. 60, pl. iv. figs. 21–36. *Pappichthys symphysis*, E. D. Cope, *loc. cit.* 1873, p. 636.—Ibid. [Vertebral centra.]

Pappichthys lævis, E. D. Cope, *loc. cit.* 1873, p. 636, and *op. cit.* 1884, p. 58, pl. iii. figs. 2–11.—Ibid. [Dentary, vertebræ, &c.; U.S. Nat. Mus. & Amer. Mus. N.H.]

Pappichthys plicatus, E. D. Cope, *loc. cit.* 1873, p. 635, and *op. cit.* 1884, p. 59, pl. iii. figs. 12–19, pl. iv. figs. 1–5.—Ibid. [Bones of skull and vertebræ.] do.

Pappichthys sclerops, E. D. Cope, *loc. cit.* 1873, p. 635, and *op. cit.* 1884, p. 57, pl. iii. fig. 1.—Ibid. [Ramus of mandible.]

Pappichthys is also recorded from the Lower Eocene of Rheims, France, by V. Lemoine, Reçh. Oiseaux Foss. Tert. Inf. Reims (1878), p. 65.

Pappichthys mongoliensis, n.s. L. Hussakof, 1932, Am. Mus. Nov. 553, p. 8, 17.7.24. Eoc. Mongolia. [Fragm. skull]

Family PACHYCORMIDÆ.

Trunk fusiform or elongate. Cranial and facial bones moderately robust, and opercular apparatus complete; mandibular suspensorium nearly vertical or inclined backwards, and gape of mouth wide; ethmoid fused with vomers and forming a prominent rostrum; premaxillæ not in contact mesially; teeth pointed and conical, usually large on part at least of all the dentigerous bones. Notochord persistent, sometimes with feeble ossifications in the sheath; vertebral arches very numerous and closely arranged. Fin-rays slender and closely set, articulated and divided distally; fulcra minute or absent. Dorsal fin short and acuminate. Scales thin and rhombic, sometimes with rounded postero-inferior angle.

Synopsis of Genera.

I. Trunk elongate, fusiform.

- No ossifications in notochordal sheath; fin-fulcra absent; pelvic fins present; dorsal fin opposed to much-extended anal fin ..... *Sauropsis* (p. 375).
- Ditto, but anal fin not much extended.... *Prosauropsis* (p. 376).
- Ossified pleurocentra and hypocentra; fin-fulcra minute; pelvic fins present; dorsal fin opposed to much-extended anal fin ..... *Euthynotus* (p. 377).
- Ossifications in notochordal sheath absent or rudimentary; fin-fulcra absent; pelvic fins absent; dorsal in advance of anal fin..... *Asthenocormus* (p. 380).

II. Trunk robust and fusiform.

- Ossifications in notochordal sheath absent or rudimentary; principal teeth round in section; pelvic fins absent; dorsal in advance of anal fin, which is not much extended..... *Pachycormus* (p. 380).
- No ossifications in notochordal sheath; principal teeth round in section; rostrum never much produced; pelvic fins small; dorsal fin arising in advance of much-extended anal fin .... *Hypsocormus* (p. 390).
- Apparently as *Hypsocormus*, but principal teeth laterally compressed, with sharp edges, in complete sockets, and rostrum often much produced ..... *Protosphyræna* (p. 399).

Ortho

~~Pleuro~~ cormus cornutus, n.g., n.s., K. Weitzel, 1930,
Abh. Senck. Naturf. Gesell. XLII. p. 101, t-f. 13-14.
Solenh. slate: Langenaltheim, Bavaria. (Compl. fish: Senckb. Mus).

see also p. 286.

Genus **SAUROPSIS,** Agassiz.

[Neues Jahrb. 1832, p. 142.]

Syn. *Diplolepis*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, p. 91.

Trunk elongate-fusiform, laterally compressed. Head relatively large, and snout not produced; marginal teeth well-spaced. No ossifications in sheath of notochord. Fin-fulcra absent. Pectoral fins large and sickle-shaped, the rays only branching and articulated at the extreme end; pelvic fins small; dorsal fin in part or completely opposed to the anal, which is high and acuminate in front and much extended as a low fringe behind; caudal fin very deeply forked. Scales minute, those of the ventral aspect much broader than deep; lateral line conspicuous.

Sauropsis longimanus, Agassiz.

1833–44. *Sauropsis longimanus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 11; pt. ii. p. 121, pl. lx.

1852. *Sauropsis longimanus*=*Pachycormus*, F. A. Quenstedt, Handb. Petrefakt. p. 218.

1860. *Sauropsis longimana*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 215.

1863. *Sauropsis longimana*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 678.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·3. Length of head with opercular apparatus equalling about one-quarter of the total length to the base of the caudal fin, and exceeding the maximum depth of the trunk. Pelvic fins arising midway between the pectorals and the anal; dorsal fin arising slightly in advance of the anal, and the anterior rays of these two fins equal in elevation.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37365. Plaster cast of type specimen; Solenhofen.

Purchased, 1863.

An undetermined species closely related to *Sauropsis longimanus* is indicated by the following specimen:—

P. 7568. Imperfect fish about 0·4 in length, dorso-lateral aspect; Oxford Clay, Christian Malford, Wiltshire.

History unknown.

Sauropsis latus, Agassiz.

1832. *Sauropsis latus*, L. Agassiz, Neues Jahrb. p. 142.
1833–34. *Sauropsis latus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 11; pt. ii. p. 122.
1860. *Sauropsis lata* = *Pachycormus elongatus* (?), A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 224.

Type. Nearly complete fish; unknown.

A large species, attaining a length of about 0·7. Length of head with opercular apparatus equalling about one-quarter of the total length to the base of the caudal fin, and not exceeding the maximum depth of the trunk. Pelvic fins arising slightly nearer to the anal than to the pectorals; origin of dorsal fin opposite to, or even somewhat behind that of the anal. Scales exhibiting a few vertical wrinkles contiguous and parallel with the anterior margin.

Form. & Loc. Upper Lias: Würtemberg and Baden.

20658 a. Imperfect large specimen, wanting the caudal fin; Boll, Würtemberg. *Purchased*, 1846.

P. 3715. Imperfect trunk of a large fish, displaying part of the squamation; Ohmden, Würtemberg. *Enniskillen Coll.*

P. 2043. Imperfect specimen, about 0·4 in length; Boll. The marginal teeth are shown, while the form and proportions of the mandible, operculum, and suboperculum are indicated. *Egerton Coll.*

Genus **PROSAUROPSIS,** Sauvage.

[Bull. Soc. Sci. Yonne, vol. xlviii. 1894, p. 4.]

An elongated fish, differing from *Sauropsis*, according to the original description, merely in the non-extension of the anal fin, which has as short a base-line as the dorsal, and perhaps in the development of slight vertebral elements.

Prosauropsis elongatus, Sauvage.

1875. *Pachycormus*? *elongatus*, H. E. Sauvage, Bibl. Ecole Hautes Etudes, vol. xiv. no. 1, p. 23, pl. ii. fig. 1.
1891. *Aspidorhynchus colombi*, H. E. Sauvage, Bull. Soc. Sci. Yonne, vol. xlv. pt. ii. p. 32 (name only).
1894. *Prosauropsis elongatus*, H. E. Sauvage, *ibid.* vol. xlviii. p. 4, pl. i. (misprinted *Protosauropsis*).

Type. Imperfect fish, ventral aspect.

The type species, attaining a length of about 0·5. Maximum depth of trunk about three times the width of the caudal pedicle,

20658a referred to as 20650, E.I. White, loc. cit. infra p. 611.

Sauropsis verminalis, E.I. White.

1925. Sauropsis verminalis, E.I. White, Ann. Mag. N.H. [9] vol. 15. p. 606, text-figs. 2-3, pls. xxxi-ii.

1952. S.v.; B. Hauff, das Holzmaden-Buch p. 25 pl. 55 f. a. (horizontal).

Types. Nearly complete fishes; British Museum.

Form. + Loc. U. Lias; Boll, Württemberg.

P. 13006. Holotype, descd. + figd. loc. cit. p. 606, + fig. 2 + pl. xxxi. Purch. 1921.

P. 13006. Paratype, " " " " " " 3 -- xxxii. " "

Sauropsis curtus, C.R. Eastman, Mem. Carnegie Mus. vol. vi (1914), p. 414, pl. lxvi. fig. 1. — Litho. Stone; Solenhofen. [Fish; Carnegie Mus., Pittsburgh.]

Sauropsis depressus, C.R. Eastman, loc. cit. p. 412, pl. lx. fig. 3. — Ibid. [Fish.]

Sauropsis (?) woodwardi, W.K. Gregory, Bull. Amer. Mus. N.H. vol. xlviii (1923), p. 230, fig. 4. — Jurassic; Cuba. [Head, &c.; A.M.N.H.]

Eugnathides browni, W.K. Gregory, loc. cit. 1923, p. 235, fig. 6. — Jurassic; Cuba. [Head; A.M.N.H.]

1898. Prosauropsis elongatus, H.E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi. p. 195.

1921. Thrissops microsodius, B. Hauff. Palaeontogr.
vol. Ixiv. p. 32.
1952. T. m. B. Hauff, das Holzmaden-Profil p. 26 pl. 38 f. 2a.

and contained seven times in the total length. Pelvic fins arising a little in advance of the middle point between the pectoral and anal fins; dorsal and anal fins directly opposed, each with about 18 rays, arising somewhat behind the middle point of the trunk. Scales smooth.

Form. & Loc. Upper Lias: Vassy, Yonne, France.

Not represented in the Collection.

Genus **EUTHYNOTUS,** Wagner.

[Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. 1860, p. 214.]

Syn. *Cyclospondylus*, F. A. Quenstedt, Handb. Petrefakt. ed. 2, 1867, p. 260.
Heterothrissops, H. E. Sauvage, Bibl. Ecole Hautes Etudes, vol. xiii. no. 5, 1875, p. 46.
Pseudothrissops, H. E. Sauvage, *ibid.* p. 46.
Parathrissops, H. E. Sauvage, Bull. Soc. Sci. Yonne, vol. xlv. pt. ii. 1891, p. 37.

A genus differing only from *Sauropsis* in the presence of well-developed hypocentra and pleurocentra surrounding the notochord, and in exhibiting minute fulcra on the median fins.

Euthynotus incognitus (Blainville).

1818. *Esox incognitus*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 325.
1833–44. *Thrissops micropodius*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12; pt. ii. p. 126, pl. lxv.
1848. *Sauropsis micropodius*, C. G. Giebel, Fauna der Vorwelt, Fische, p. 200.
1852. *Thrissops micropodius*, F. A. Quenstedt, Handb. Petrefakt. p. 218, pl. xvii. fig. 18.
1858. *Thrissops micropodius*, F. A. Quenstedt, Der Jura, p. 237, pl. xxxiii. figs. 3–7.
1860. *Euthynotus micropodius*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 218.
1867. *Cyclospondylus*, F. A. Quenstedt, Handb. Petrefakt. ed. 2, p. 260.
1875. *Pseudothrissops micropodius* (errore *micropterus*), H. E. Sauvage, Bibl. Ecole Hautes Etudes, vol. xiii. no. 5, p. 46.
1887. *Euthynotus micropodius*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 225, woodc. fig. 238.

Type. Nearly complete fish; Paris Museum of Natural History.

The type species, attaining a length of about 0·35. Length of head with opercular apparatus equalling somewhat more than one-fifth of the total length to the base of the caudal fin, and exceeding

the maximum depth of the trunk. Pelvic fins arising slightly nearer to the pectorals than to the anal; dorsal fin about as long as deep, arising opposite the middle of the anal.

Form. & Loc. Upper Lias: Würtemberg.

P. 2044. Imperfect specimen about 0·3 in length; Ohmden.

Egerton Coll.

P. 881 a. Imperfect head and abdominal region; Ohmden.

Egerton Coll.

Euthynotus intermedius (Agassiz).

1844. *Thrissops intermedius*, L. Agassiz (*ex* Münster, MS.), Poiss. Foss. vol. ii. pt. ii. p. 127, pl. lxvi.

1848. *Sauropsis intermedius*, C. G. Giebel, Fauna der Vorwelt, Fische, p. 200.

1860. *Euthynotus intermedius*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 217.

1875. *Heterothrissops intermedius*, H. E. Sauvage, Bibl. Ecole Hautes Etudes, vol. xiii. no. 5, p. 46.

Type. Nearly complete fish; Woodwardian Museum, Cambridge.

A species about as large as the type. Length of head with opercular apparatus equalling one-quarter of the total length to the base of the caudal fin, and about equal to the maximum depth of the trunk. Pelvic fins much nearer to the pectorals than to the anal; dorsal fin much deeper than long, arising opposite the origin of the anal.

This is the type species of the so-called genus *Heterothrissops*.

Form. & Loc. Upper Lias: Werther, Westphalia.

Not represented in the Collection.

Euthynotus speciosus, Wagner.

1860. *Euthynotus speciosus*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 216.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species about as large as the type, characterized by the comparatively robust proportions of the trunk and the forward position of the dorsal fin, which arises opposite or immediately in advance of the origin of the anal fin.

Form. & Loc. Upper Lias: Werther, Westphalia.

Not represented in the Collection.

1985. Erythrolites intermedius, C. Brambury,
p. 21, fig. 10, pl. iii. f. 1. (Yorne).
Incl. Calinus atlanis q.v. p 379.
Parathrissops nitidi q.v. p. 379.

1898. Euthynotus millotii, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi. pp. 195, 200.

Euthynotus sp., A. S. Woodward, Proc. Cheltenham Nat. Sci. Soc., n. s., vol. i (1911), pp. 322, 323. — Upper Lias; Dumbleton, Glos. [Imperfect fish; Cheltenham Museum.]

Euthynotus milloti (Sauvage).

1891. *Parathrissops milloti*, H. E. Sauvage, Bull. Soc. Sci. Yonne, vol. xlv. pt. ii. p. 37, pl. i. fig. 1, pl. ii. figs. 1, 3. = E. incognitus q.v. p. 378.

Type. Imperfect fish, wanting caudal fin.

The type species of the so-called genus *Parathrissops*, attaining a length of about 0·25. Length of head with opercular apparatus equalling the maximum depth of the trunk and contained about four-and-a-half times in the total length to the base of the caudal fin. Distance between the pelvic and anal fins twice as great as that between the former and the pectorals; dorsal fin with 15 or 16 rays, arising slightly in advance of the anal, which comprises 34 rays.

Form. & Loc. Upper Lias: Yonne, France.

Not represented in the Collection.

The following imperfect specimens appear to represent a species distinguished from the known forms by the more robust proportions of the trunk. So far as can be ascertained, the length of the head with opercular apparatus is about equal to the maximum depth of the trunk and contained four times in the total length to the base of the caudal fin. The dorsal and anal fins are arranged as in the type species, *E. incognitus*.

19648–49. A much-fractured distorted fish, in counterpart, with upturned head, wanting the caudal fin; Upper Lias, Boll, Würtemberg. The operculum exhibits fine tuberculations, and there is an apparently false suggestion of a peg-and-socket union in the ventral scales of the abdominal region. *Purchased*, 1845.

P. 880. Hinder portion of head and greater portion of trunk, displaying the axial skeleton; Upper Lias, Ohmden, Würtemberg. *Egerton Coll.*

19651. A more imperfect specimen; Boll. *Purchased*, 1845.

To *Euthynotus* may also be referred a small fish from the Upper Lias of Vassy, Yonne, France, described under the name of *Caturus cotteaui* (H. E. Sauvage, Bibl. Ecole Hautes Etudes, vol. xiv. 1875, no. 1, p. 15, pl. i. fig. 1; Bull. Soc. Sci. Yonne, [3] vol. vii. 1883, p. 45; and Bull. Soc. Hist. Nat. Autun, vol. iv. 1891, p. 77). Probably young of Euthynotus milloti acc. to H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi (1898), p. 195. Boll = Euthynotus incognitus q.v. p. 378.

Genus **ASTHENOCORMUS**, nomen nov.

Syn. *Agassizia*, B. Vetter (*non* Agassiz, 1846, *nec* Valenciennes, 1847), Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, p. 97.

Trunk elongate. Head relatively large, and snout not produced; teeth minute and clustered; gular plate present. Ossifications in sheath of notochord rudimentary or absent. Fin-fulcra absent. Pectoral fins large and sickle-shaped, the rays only branching and articulated at the extreme end; pelvic fins absent; dorsal in advance of the anal fin; caudal fin very deeply forked. Scales minute, those of the ventral aspect much broader than deep; lateral line inconspicuous.

Asthenocormus titanius (Wagner).

1852. *Caturus* sp., F. A. Quenstedt, Handb. Petrefakt. p. 216.
1863. *Eugnathus titanius*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 670.
1881. *Agassizia titania*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 97, pl. iii.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of nearly 2 metres. Length of head with opercular apparatus about twice as great as the maximum depth of the trunk, and contained somewhat less than four times in the total length of the fish. External bones unornamented, exhibiting only their fibrous texture; teeth smooth, many acutely pointed and slightly arched; operculum broader than deep. Dorsal fin arising at about the middle point of the back; lobes of caudal about equal in length to the pectoral fins. Scales all broader than deep.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

Not represented in the Collection.

Genus **PACHYCORMUS**, Agassiz.

[Poiss. Foss. vol. ii. pt. i. 1833, p. 11.]

Syn. (?) *Saurostomus*, L. Agassiz, *ibid.* 1833, p. 14.
Cephenoplosus, H. E. Sauvage, Revue Sci. Nat. vol. ii. 1874, p. 428.

Trunk laterally compressed and irregularly fusiform, relatively deep in the abdominal region, very narrow at the extremity of the caudal pedicle. Head much less deep than the trunk, the occipital region of the cranial roof raised into a large median eminence to meet the laterally-compressed dorsal border of the trunk; teeth round in section; suboperculum at least as large as the operculum; gular plate present. Ossifications in sheath of notochord absent or

The supposed intestine with spiral valve of Asthenocormus is interpreted as air-bladder by C. R. Eastman, Mem. Carnegie Mus. vol. vi (1914). p. 415, 416.

1914. Asthenocormus titanius, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 416.

Asthenocormus retrodorsalis, C. R. Eastman, Mem. Carnegie Mus. vol. vi. (1914). p. 417, text-figs. 6, 7. — Litho. Stone; Solenhofen. [Imperfect fish; Carnegie Mus., Pittsburgh.]

For structure of skull of *Pachycormus* see A. S. Woodward, Mém. Soc. Linn. Normandie, vol. xxiii (1908), p. 29, with restored head-fig.

insignificant. Fin-fulcra minute or absent. Pectoral fins large and sickle-shaped, the rays only branching and articulated at the extreme end; pelvic fins absent; dorsal in advance of the anal fin, which is not much extended; caudal fin very deeply forked. Scales small and very deeply imbricating, those of the ventral aspect scarcely broader than deep; lateral line conspicuous.

The most characteristic feature in the skull of this genus is the median elevation of the parieto-occipital region, which affects a sharply-defined triangular area at the hinder end of the cranial roof. The roof-bones themselves appear to be all fused together into a continuous shield, and the surface is completely covered with a very fine granular ornament. Traces of the sutures between the frontals, squamosals, and parietals are, however, sometimes seen; and the frontals are thus shown to form the greater part of the hinder elevation. The elements in the otic region are well ossified, though not hitherto precisely determined; but there appears to be no ossified interorbital septum. The parasphenoid, when viewed from the side, is observed to be gently arched, bulging slightly downwards; while the vomers seem to be completely fused with the mesethmoid. Of the facial bones, by far the largest and most conspicuous are two suborbitals (postorbitals), which occupy nearly the whole of the cheek between the preoperculum and the orbit. The circumorbitals are comparatively small, and have only been satisfactorily observed as a series of little plates, all broader than deep, on the anterior border of the suborbitals. The sclerotic capsule is ossified. The maxilla is long and slender, tapering in front, deepest behind; and its hinder margin is excavated to receive a large, short, and deep supramaxilla, which does not extend upwards on the cheek higher than the maxilla itself. The premaxilla has not been observed, and may perhaps be fused with the rostrum. The structure of the mandible is not yet satisfactorily known; but the splenial is evidently a delicate plate with comparatively minute teeth, while the angular bone occupies only a short extent of the outer face of the ramus.

There is a large gular plate completely covering the anterior portion of the space between the mandibular rami, while the branchiostegal rays are short and numerous, often as many as 50. Of the opercular apparatus the most characteristic feature is the very large size of the subopercular, which is trapezoidal in form and throws sharply forwards the apex of the triangular operculum. The preoperculum and interoperculum are narrow and comparatively small. The supratemporal plates resemble those of *Amia*.

The notochord must have been always persistent, though there

are perhaps rare traces of slight ossifications in its sheath both in the abdominal and caudal regions. The neural and hæmal arches, however, are all well ossified, numerous, slender, and very closely arranged; while the lamina of each arch is remarkably deep and narrow, and might readily be mistaken for a vertebral element. The ribs are especially slender, not extending to the ventral border of the abdomen; and the sigmoidally-bent neural spines in the abdominal region remain separate from their supporting arches, fusion not taking place until a point considerably behind the origin of the dorsal fin. In the caudal region all the spines are firmly fused both with the neural and hæmal arches, while in its hinder half they increase in robustness and in backward inclination. It is also noteworthy that one hæmal arch develops into a great fan-shaped expansion, for the more adequate support of the powerful caudal fin. There are no intermuscular bones.

The clavicle is large and extends far forwards in the gular region to meet its fellow of the opposite side. There are also large post-clavicular plates. The rays of the pectoral fin are very closely apposed, and only divided quite at the distal extremity; its anterior margin sometimes exhibits a fringe of relatively minute fulcra. No pelvic fins have been observed in any species. The rays of the median fins are very slender and exhibit distant articulations, which sometimes appear as if incomplete or secondarily fused. At the anterior margin of each fin the rays gradually increase in length to its apex; but there are very rarely traces of minute fulcra between their successive points. A few free fin-supports occur above the neural spines in advance of the dorsal fin.

The scales are all thin and very deeply overlapping, not strengthened by ribbings within or united by peg-and-socket. On the flank the rhombic exposed areas are about as deep as broad, while towards the ventral border a few are broader than deep. There is one greatly enlarged scale near the origin of the anal fin. The lateral line is distinctly traceable on the flank, and in a few specimens it is shown to bifurcate irregularly on some of the scales in the abdominal region.

The form of the trunk in *Pachycormus* is such that it assumes very varied outlines when crushed. Moreover, the apparent size of the scales differs greatly according to the degree and manner in which they are displaced. The determination of the species is thus very difficult and uncertain, and many more forms have been named than it is possible to define. In the following provisional arrangement the relative depth of the trunk is thus ignored in the diagnoses,

1908. Pachycormus macropterus, A.S. Woodward,
Mem. Soc. Linn. Normandie, vol. xxiii. p. 29, pl. iii. f. 1,
& text-fig. A skull restored.

1948. P. m. J-P. Lehman K. Sv. Vet. Ak. Handl. (4) 1 no. 2.
p. 8. ~~Fig. 1-5~~ Figs. 1-5, 7, 9, 10, 15, 17, pls I-IV; V, 1; IX, 12

1952. P. m. B. Haufft. Das Holzmadener Fisch p. 20 pl. 53 f a

P. 12913. Fine fish prepared by Haufft;
Holzmaden. Haufft Coll.

while the form and proportions of the head and operculum are regarded as the most important specific characters.

Pachycormus macropterus (Blainville).

1755. Figure by A. J. Dezallier d'Argenville, Oryctologie, pl. xviii. fig. 1.

1805. Figure by B. Faujas St. Fond, Essai de Géologie, vol. i. p. 122, pl. viii.

1818. *Elops macropterus*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 324.

1833–44. *Pachycormus macropterus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12; pt. ii. p. 111, pl. lix. *a*.

1848. *Pachycormus macropterus*, C. G. Giebel, Fauna d. Vorw., Fische, p. 197.

1858. *Pachycormus macropterus*, F. A. Quenstedt, Der Jura, p. 236, pl. xxxii. fig. 5.

1860. *Pachycormus macropterus*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 221 (in part).

1883. *Pachycormus macropterus*, H. E. Sauvage, Bull. Soc. Linn. Normandie, [3] vol. vii. p. 144, pl. iv.

(?) 1887. *Pachycormus macropterus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 224, fig. 237.

Type. Nearly complete fish; Paris Museum of Natural History.

The type species, attaining a length of about 1·0. Head with opercular apparatus occupying somewhat more than one-quarter of the total length of the fish; head much elongated and snout obtuse, the ratio between the length of the head from the median elevation to the end of the snout and the width of the head near the occiput being 9 : 7; operculum triangular, almost or quite as broad as deep, and branchiostegal rays about 50 in number. Dorsal fin with about 30–35 rays, arising at the middle point of the back and well in advance of the anal fin, which is equally extended. Scales of moderate size, mostly smooth but in part faintly rugose.

Form. & Loc. Upper Lias: N. and E. France; Würtemberg; Somersetshire & Yorkshire.

20657. Specimen 0·96 in length, with imperfect head; Boll, Würtemberg. The anal fin is shown well behind the dorsal, and about 28 rays can be counted in each.

Purchased, 1846.

P. 7569. Imperfect fish about 0·7 in length; Ohmden, Würtemberg. Some of the dorsal scales are ornamented with a faint rugosity. *Purchased.*

P. 3719. Another large trunk with fragmentary remains of the head; Ohmden. *Enniskillen Coll.*

P. 3707. Imperfect fish, ventro-lateral aspect; Ohmden. *Enniskillen Coll.*

P. 2045. Head and a well-preserved portion of the abdominal region of a large fish; Ohmden. About 35 supports can be counted in the dorsal fin. *Egerton Coll.*

P. 3719 a. More imperfect head and portion of abdominal region of another fish about 0·65 in length; Ohmden. *Enniskillen Coll.*

32433. Head and opercular apparatus 0·185 in length; Curcy, Normandy. The proportions of the cranial roof are obtained from this specimen. *Tesson Coll.*

32432, 32436. Two fragmentary heads; Curcy. *Tesson Coll.*

P. 7570. Imperfect head showing the extremity of the snout, with part of the right pectoral fin and some anterior scales; Ilminster, Somersetshire.

Pachycormus acutirostris, Agassiz.

1844. *Pachycormus acutirostris,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 114.

Type. Imperfect head.

An imperfectly-known species of moderate or large size. Head closely similar to that of *P. macropterus*, but with a slightly shorter snout; operculum triangular, with somewhat truncated upper extremity, nearly as broad as deep; branchiostegal rays about 45–50 in number. Scales of moderate size, ornamented with a feeble rugosity.

Form. & Loc. Upper Lias: Yorkshire.

P. 7571. Fragmentary remains of fish about 0·55 in length, ventral aspect; Whitby. *Purchased.*

P. 3705 c. Anterior half of a similar specimen, displaying the left branchiostegal rays; Whitby. *Enniskillen Coll.*

P. 2038, P. 3706. Much fractured remains of the head and abdominal region of a very large fish, in counterpart; Whitby. *Egerton & Enniskillen Colls.*

P. 884 a–e. Five heads in various states of preservation; Whitby. *Egerton Coll.*

1896. Pachycormus acutirostris, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii. p. 165, pl. xxi. figs. 2–4.

P. 8844. Del. & fig. Ow. cit. 1896, p. 167, pl. xxi. fig. 4.

P. 3705a. Des? & figs. loc. cit. 1896, p. 165, pl. xxi. figs. 2, 2a.
P. 3705b. Jaws des? & figs. loc. cit. 1896, p. 168, pl. xxi. fig. 3.

Does it belong here?
1954. P.C. B. Woodward, p. 24 pl. 53 f. b.
1896. Pachycormus curtus, A.S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii. p. 161, pl. xxi. fig. 1.
1898. Caturus chaperi = Pachycormus curtus, H.E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi. p. 196, pl. xiv.
1935. Pachycormus curtus, C. Arambourg, p. 9, 16. 4-5. (Gard).
1938a " aff. " A.S. Woodward, pl. i. fig.
1948. P.C. E.H. Rayner Ph. Tr. R.S. 233 B. p. 311 figs 17, 18.

1898. Caturus stenoura = Pachycormus stenoura, H.E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi. p. 200.

P. 3705 a, b, e, P. 3710 c. Four similar specimens; Whitby. *Enniskillen Coll.*

P. 884 f, P. 3703. Another head, in counterpart; Whitby. *Egerton & Enniskillen Colls.*

P. 3705 d. Portion of opercular apparatus and anterior squamation; Whitby. *Enniskillen Coll.*

Pachycormus curtus, Agassiz.

1832. *Urœus gracilis,* L. Agassiz, Neues Jahrb. p. 142.
1833–44. *Pachycormus gracilis,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12; pt. ii. p. 114 (undefined).
1844. *Pachycormus curtus,* L. Agassiz, *ibid.* pt. ii. p. 112, pl. lix.
1844. *Pachycormus latus,* L. Agassiz, *ibid.* pt. ii. p. 114. [Portion of fish; British Museum.]
1843. *Pachycormus curtus,* F. A. Quenstedt, Flözgeb. Württemb. p. 244.
1858. *Pachycormus curtus,* F. A. Quenstedt, Der Jura, p. 235, pl. xxxii. fig. 4.
1860. *Pachycormus curtus,* A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 225.

Type. Nearly complete fish; British Museum.

A stout species of moderate size, attaining a length of about 0·5. Head much shorter than in the type species, and this with the opercular apparatus occupying more than one-quarter of the total length of the fish; operculum triangular, deeper than broad, and branchiostegal rays about 40 in number. Scales of moderate size and smooth.

Variously crushed examples of *Pachycormus* from the Upper Lias of the Dept. Yonne, France, not yet clearly defined and distinguished from *P. curtus*, have received the names of *Caturus stenospondylus* (H. E. Sauvage, Bibl. École Hautes Études, vol. xiv. 1875, no. 1. p. 13, pl. iii.; Bull. Soc. Sci. Yonne, [3] vol. vii. 1883, p. 41; and Bull. Soc. Hist. Nat. Autun, vol. iv. 1891, p. 75); *Caturus stenoura* (H. E. Sauvage, *loc. cit.* 1875, p. 18, pl. i. fig. 2; *loc. cit.* 1883, p. 46, pl. ii. fig. 2; and *loc. cit.* 1891, pp. 78, 81, pl. viii.); and *Caturus chaperi* (H. E. Sauvage, *loc. cit.* 1883, p. 43, pl. ii. fig. 1; and *loc. cit.* 1891, p. 76, pl. vi.). Another fish from the Upper Lias of Werther, Ravensberg, Westphalia, also not clearly distinguished from *P. curtus* (and thus provisionally determined by F. A. Roemer, Verstein. norddeutsch. Oolithen-geb., Nachtr. 1839, p. 53), is named *P. crassus* (A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. 1860, p. 226). Here also may perhaps be placed the undefined *Caturus meyeri* (L. Agassiz, *ex* Münster MS., Poiss. Foss. vol. ii. 1844, p. 118) from Werther.

Form. & Loc. Upper Lias: Yorkshire, Gloucestershire, and Somersetshire; N. France; Würtemberg.

P. 464, P. 3698. Type specimen in split nodule; Whitby. The appearance of each support of the anal fin being in connection with more than one ray, noted by Agassiz, is deceptive, as proved by other specimens.
Egerton & Enniskillen Colls.

P. 3710. Finer specimen of the same size in shale, with the left pectoral fin and well-preserved caudal fin; Whitby. The head and anterior abdominal region are partly distorted.
Enniskillen Coll.

P. 885, P. 3710 a. Another specimen of the same size in shale, in counterpart, more imperfect but with the pectoral fin; Whitby. *Egerton & Enniskillen Colls.*

P. 2037. Somewhat larger imperfect and distorted fish; Whitby.
Egerton Coll.

P. 2037 a, P. 3712. Remains of a fish about 0·32 in length in nodule, wanting all the fins except the pectoral; Whitby.
Egerton & Enniskillen Colls.

P. 2037 b, P. 3710 b. Head and greater portion of trunk, ventral aspect, in counterpart; Whitby. Minute fulcra are distinctly shown on the anterior border of the right pectoral fin. *Egerton & Enniskillen Colls.*

P. 3700. Imperfect head and greater portion of trunk; Whitby.
Enniskillen Coll.

P. 3711. A distorted fish elongated by crushing, labelled *Pachycormus gracilis* by Agassiz; Whitby. *Enniskillen Coll.*

P. 3699. Very imperfect and partially manufactured large specimen, with scattered scales, and trunk much deepened by crushing, labelled *Pachycormus latus* by Agassiz and intended to be the type of that species; Whitby. The counterpart of the pectoral fin is fixed above the head.
Enniskillen Coll.

P. 3716. Hinder portion of head and greater portion of imperfectly-preserved trunk; Dumbleton, Gloucestershire.
Enniskillen Coll.

19652. Imperfect specimen about 0·27 in length, wanting the greater part of the head and caudal fin; Boll, Würtem-

P.4464. Des? Lon. cit. 1896, p. 162.

P.3710. Des? & fig? Lon. cit. 1896, p. 163, pl. xxi. fig. 1.

P.885. Noticed Lon. cit. 1896, p. 164.

P.2037. Neural spines noticed Lon. cit. 1896, p. 164.

P.3711. Noticed Lon. cit. 1896, p. 164.

P.3699. Des? Lon. cit 1896, p. 164.

berg. The expanded, fan-shaped hæmal spine is shown at the base of the tail. *Purchased*, 1845.

18515–16. Remains of large fish about 0·34 in length, and another specimen wanting tail; Boll. *Purchased*, 1844.

20658. Another large specimen, distorted and imperfectly preserved; Boll. *Purchased*, 1846.

P. 3718. Two more imperfect specimens, one showing the expanded hæmal at the base of the caudal fin; Ohmden, Würtemberg. *Enniskillen Coll.*

P. 2045 a, b. Head and pectoral fin, with portion of abdominal region, also an imperfect fish exposed from the ventro-lateral aspect; Ohmden. *Egerton Coll.*

19646. Imperfect fish; Ohmden. *Purchased*, 1845.

P. 881. Small trunk displaying the median fins and showing the enlarged scale at the origin of the anal fin; Ohmden. *Egerton Coll.*

32424. Large fish originally about 0·5 in length, but wanting tail; Curcy, Normandy. The proportions of the head are shown, and a supratemporal plate seems to be one of a pair resembling that of *Amia*. The axial skeleton of the trunk is well displayed, and there are a few free fin-supports above the sigmoidal neural spines in advance of the dorsal fin. The right pectoral fin bears minute fulcra. *Tesson Coll.*

32425, 32427, 32430–31. Four specimens of moderate size, variously imperfect; Curcy. The first two specimens exhibit an undigested young *Pachycormus*, and the fourth the bones of a *Leptolepis* in the stomach. The third shows the expanded hæmal arch at the base of the tail, and free dorsal fin-supports. *Tesson Coll.*

32426, 32428–29. Three large portions of fishes, the first showing the anal scale and a swallowed small fish, the second illustrating the branching of the lateral line on some of the anterior scales; Curcy. *Tesson Coll.*

32443. Fragmentary small specimen displaying the parasphenoid in side view, some of the otic bones, and the axial skeleton of the trunk; Curcy. *Tesson Coll.*

32435. Small head and left pectoral fin, this displaying three basal fulcra and a close series of minute fulcra beyond ; Curcy. *Tesson Coll.*

32432, 32434. Two small heads, the first displaying the branchiostegal rays, the second exhibiting the cranium and cheek-plates ; Curcy. *Tesson Coll.*

32437–39, 39 a. Four fragmentary heads with anterior scales, those of the last specimen faintly rugose ; Curcy. *Tesson Coll.*

35583. Remains of head and trunk either of this species or *P. acutirostris* ; Whitby. *Purchased*, 1859.

Pachycormus (**Saurostomus**) **esocinus** (Agassiz).

1833–44. *Saurostomus esocinus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 14 ; pt. ii. p. 144, pl. lviii. *b*. fig. 4.

1844. *Eugnathus giganteus*=*Pachycormus giganteus*, L. Agassiz, *ibid.* pt. ii. pp. 104, 114 (undefined). [Imperfect fish ; British Museum.]

1844. *Pachycormus latirostris*, L. Agassiz, *ibid.* pt. ii. p. 114. [Imperfect head ; British Museum.]

1848. *Pachycormus esocinus*, C. G. Giebel, Fauna d. Vorw., Fische, p. 197.

1848. *Pachycormus latirostris*, C. G. Giebel, *ibid.* p. 198.

1848. *Eugnathus giganteus*, C. G. Giebel, *ibid.* p. 238.

1858. *Pachycormus bollensis*, F. A. Quenstedt, Der Jura, p. 237, pl. xxxii. fig. 6. [Imperfect fish ; Tübingen University Museum.]

(?) 1878. *Pachycormus westermani*, T. C. Winkler, Archiv. Mus. Teyler, vol. v. p. 9, pl. i. [Imperfect fish ; Teyler Museum, Haarlem.]

1891. *Caturus gigas*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. iv. p. 74, pl. vii. [Head.]

Incl. Cephenoplias g.v. p. 390.

Type. Dentary bone ; *olim* Walchner Coll.

A large species, attaining a length of not less than 1·0. Head with opercular apparatus occupying one-quarter of the total length of the fish ; head very short and stout, and teeth relatively larger than in the other species ; operculum as broad as deep, trapezoidal in form, and the upper border shortest ; branchiostegal rays somewhat less than 40 in number. Dorsal and anal fins about equally extended, with not less than 30 rays, the latter arising just in advance of a point opposite the hinder end of the former. Scales of the lateral line on the caudal region somewhat enlarged.

This is the type species of the so-called genus *Saurostomus*, and further researches must determine definitely whether or not its universally-accepted reference to *Pachycormus* is correct. The characteristic median elevation of the parieto-occipital region of the

1952. P. esocinus, P. bollensis, P. sp. B. Hauff
der Holzmaden Buch p. 24 pls 51, 52, 54.

A specimen in Hauff's workshop shows that the fin was long, not as indicated by A.S.W. but with one anterior ray, but acutely s.s.

Prelim. note on P. bollensis by F. Leuthardt, Tätigkeitsber. naturf. Ges. Baselland, 1902-03 (Liestal 1904), p. 11.

1898. Catervus pipas = Pachycormus (Saurostomus) esocinus, H.E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi. p. 196.

1896. Pachycormus (Saurostomus) esocinus, A.S. Woodward, Proc. Belf. Nat. Hist. Antiq. Field Club, vol viii. p. 241.

1896. Saurostomus esocinus, A.S. Woodward, Proc. York. Geol. Polyt. Soc. vol. xiii. p. 158, pl. xx.

1896. Pachycormus bollensis, H. Scupin, Archiv f. Naturgesch. vol. i, p. 174 [structure of scales].

1916. Saurostomus esocinus, A.S. Woodward, Geol. Mag. [6] vol. iii. p. 49, pl. ii.

1921. Pachycormus esocinus, B. Hauff, Palaeontogr. vol. lxiv. p. 31, pl. xx. fig. 1.

1938. Pachycormus bollensis, Gaitormsen, p. 33, fg 29-30 (histology figs).

A specimen in Naturaliencab. Stuttgart shows the much-elongated pectoral fin-ray. [May 1912.]

P.11126. Nearly complete fish, des? & fig? A.S.W. loc. cit. 1916; Holzmaden, Württemberg. Hauff Coll. also by Hauff 1952 p. 52 f. 6. (P. sp.)

P.3709. Noticed loc. cit. 1896, p. 160.

P.3708. Des? & fig? A.S. Woodward, Pro. Yorks. Geol. Polyt. Soc. vol. xiii (1896), p. 159, pl. xx. fig. 1, 1a.

P.2039. Noticed loc. cit. 1896, p. 161.

P.3709a. Des? & fig? loc cit. 1896, p. 160, pl. xx. fig. 2. Probably of Pachyc acutirostris.

cranium has not hitherto been observed. One of the finest known specimens, in the Moore Collection, Bath Museum, was obtained from the Upper Lias of Ilminster, Somersetshire.

Form. & Loc. Upper Lias: Baden and Würtemberg; Yonne, France; Yorkshire and Somersetshire.

P. 7572. Imperfect fish, lateral aspect and partly in counterpart, about 0·76 in length, and wanting the greater part of the caudal fin; Ohmden, Würtemberg. The characteristic operculum of the right side is shown in position, while that of the left side is displaced to the ventral border of the abdominal region. The dorsal and anal fins are displayed in their natural position, and the tolerably well-preserved squamation is remarkable for the number of series in which the exposed portion of the scale is much broader than deep. *Egerton Coll.*

P. 3731. Imperfect head and abdominal region of a larger specimen, ventral aspect, noticed by Agassiz, *loc. cit.*, under the name of *Eugnathus giganteus* or *Pachycormus giganteus*; Boll, Würtemberg. *Enniskillen Coll.*

P. 2040. Imperfect head and pectoral fins; Würtemberg. *Egerton Coll.*

P. 2042. Head and displaced pectoral fin; Ohmden. *Egerton Coll.*

P. 3709. Imperfect small head and pectoral fins, with remains of abdominal region, labelled *Pachycormus latirostris* by Agassiz; Whitby, Yorkshire. *Enniskillen Coll.*

P. 3708. Crushed and imperfect head, labelled *Pachycormus latirostris* by Agassiz; Whitby. The solid rostrum is shown with its marginal teeth; and the left operculum is well displayed. *Enniskillen Coll.*

P. 2039, P. 4280. Fragmentary remains of large head and pectoral fin, in counterpart; Whitby. *Egerton & Enniskillen Colls.*

P. 3709 a. Pectoral fin; Whitby. *Enniskillen Coll.*

P. 5954. Imperfect mandible; Ohmenhausen. *Purchased*, 1889.

P. 3719 b. Small trunk apparently of this species, displaying the dorsal and anal fins; Ohmden, Würtemberg. The spiral intestine is beautifully exhibited by its coprolitic contents. *Enniskillen Coll.*

The following specimens are not specifically determined:—

P. 3704. Imperfect head and abdominal region, the latter much deepened and with remarkably small scales; Upper Lias, Ilminster, Somersetshire. The operculum is triangular and slightly deeper than broad. *Enniskillen Coll.*

P. 900. Imperfect head, pectoral fin, and anterior scales of a small fish; Ilminster. *Egerton Coll.*

32245. Remains of small fish with relatively small scales; Upper Lias, Curcy, Normandy. *Tesson Coll.*

An imperfect head of *Pachycormus* from the Upper Lias of Lozère, France, has also been described under the name of *Cephenoplosus typus* by H. E. Sauvage, Revue Sci. Nat. vol. ii. (1874), p. 430, pl. viii. Nothing is known of the species from the Lower Lias of Lyme Regis named *Pachycormus leptosteus* by Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), p. 114.

The fragmentary head and pectoral fin described as follows is commonly compared with *Pachycormus*:—

Saurichthys gigas=*Lycodus gigas*, F. A. Quenstedt, Der Jura (1858), p. 240, pl. xxxiii. fig. 1.—Upper Lias; Holzmaden, Würtemberg. [Tübingen University Museum.]

Quenstedt places next to this some problematical cranial bones from the Upper Lias of Ohmden, described under the provisional name of *Pachylepis*, *op. cit.* p. 241, pl. xxxiii. figs. 12–15.

Genus **HYPSOCORMUS,** Wagner.

[Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. 1860, p. 214.]

Trunk laterally compressed and irregularly fusiform, relatively deep in the abdominal region, very narrow at the extremity of the caudal pedicle. Head small and less deep than the trunk; rostrum moderately produced; premaxilla large and triangular in shape; maxilla long and slender. Dentition powerful, all the principal teeth round or oval in section, without sharp edges, and fixed in incomplete sockets; those of the vomerine and splenial bones especially large; those of the maxilla, premaxilla, and dentary in a single widely-spaced series, with minute clustered teeth externally; those of the pterygoid bones more or less granular. Gular plate present. Ossifications in sheath of notochord absent; ribs short and slender. Fin-fulcra minute or absent. Pectoral fins large and sickle-shaped, with straight anterior border stiffened by the fusion of the foremost three or four rays, which gradually increase

Chondenia multidentata g.n.s.n. Lais 2
Wiltenburg, B. Hamff 1953 Neues Jahrb., G. P. Abh. 97
p. 39, Tf. 1-3 pls. 39-50 [Scattered remains:
said to be palaeoniscid but looks like v. Layer Sammst. essarnii
B. Hamff 1952 Holzmaden Buch p. 22 pl. 40.

Pachylepis - see Chondrosteus lindenbergi: 9, 34.
[illegible] p. 15E.

Microlepidotus T. Greig 1851 Proc. Zool. (2) 2 pl. 4.

Nemoracanthus Rayner 1948 Ph. Tr. R. S.
233 B. p. 310 Tf. 16. palaeoniscid
H. P. Lehman 1949 K. Sv. Vet. A. K. Handl. (4) 1:2
p. 34 Tf. 14, 18-23 pl. v. f. 2 pl. vi viii, ix f. 5.
N. Holmgren & E. A. Stensiö 1936, in Bolk et. Handb. vergl. Anat.
Wirbeltiere 4: 483, f. 366.

For cranial roof, &c., of Hypsocormus, see A.S. Woodward, Mém. Soc. Linn. Normandie, vol. xxiii (1908), p. 32, pl. iii. fig. 2. Nemoicanmin, D.H. Rayner 1941. Biol Rev. 16 p. 235 tf. 12 c.

H. sp. Hölzmaden B. Hauff 1952 das Hölzmaden
p. 25 pl. 55 f. 6.

1914. Hypsocormus insignis, C.R. Eastman, Mem. Carnegie Inus. vol. vi. p. 414, pl. 7 xxi. fig. 3.
1935. Hypsocormus insignis. W. Frost, p. 53, tf 30 (mandible)

in length and are not branched distally; pelvic fins small; dorsal fin partly or completely in advance of the anal, which is much extended; caudal fin very deeply forked. Scales small and deeply imbricating, those of the ventral aspect much broader than deep; lateral line inconspicuous.

So far as known, the osteology of this genus is almost identical with that of *Pachycormus*, as already described; but there is a distinct premaxilla and the dentition is much more powerful. The same characteristic arrangement of the suborbital and circumorbital bones is observable; the sclerotic is also well-ossified; and the posteriorly-placed supramaxilla is identical in the two genera. The maxilla does not articulate directly with the cranium or pterygo-palatine arcade, but is suturally united with the premaxilla; and the latter element is apposed to an extended groove in the lateral ethmoidal region along its narrow antero-superior border. The vomers are clearly shown to be fused with the mesethmoid; and their pair of large teeth is directly opposed to a similar pair in the splenials. The latter elements are much thickened where they meet in the mandibular symphysis; but they rapidly taper backwards, again expanding in the hinder half of the ramus into a thin laminar plate apparently covering the whole of the inner face of the jaw and armed with minute, almost granular teeth. The teeth of the dentary are borne on a thickened ledge on the inner face of the bone. Between the mandibular rami there is a large, azygous gular plate, followed by a numerous series of short branchiostegal rays. The only important differences in the trunk seem to be, the presence of small pelvic fins and the elongation of the anal fin.

Hypsocormus insignis, Wagner.

[Plate XIV. fig. 1.]

1860. *Hypsocormus insignis*, A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. p. 221.
1863. *Hypsocormus insignis*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 677.
1881. *Hypsocormus insignis*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 95.
1887. *Hypsocormus insignis*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 226, woodc. fig. 239.

Type. Imperfect fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·7. Length of head with opercular apparatus equalling about one-quarter of the total length to the base of the caudal fin, and less than the maximum depth of the trunk. Snout short and obtuse, and external

bones finely granulated. Pelvic fins arising much nearer to the pectorals than to the anal fin. Dorsal fin with about 24 rays; anal with nearly 50 rays. Scales smooth.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

49144. Plaster cast of type specimen; Solenhofen.

Purchased, 1878.

P. 6942. A nearly complete fish about 0·75 in total length; Eichstädt. The head is obscure, but some of the large mandibular teeth are shown and parts of the external bones are distinctly ornamented with very fine tubercles. The axial skeleton of the trunk is well preserved and there are no traces of ossifications in the notochordal sheath. There are at least 120 segments. In the abdominal region the two halves of the long neural arches are separate both from each other and from the sigmoidally-bent neural spines. The latter are shorter than their supporting arches, shortest beneath the anterior half of the dorsal fin, thickest and most widely spaced anteriorly immediately behind the head. The ribs are remarkably slender and short, not half encircling the abdominal cavity. The neural and hæmal spines are fused with their supporting arches in the caudal region, much inclined backwards and approximately symmetrical, except at the base of the caudal fin where the hæmals are much enlarged. The left pectoral fin and both the pelvic fins are preserved, both of relatively small size, but the latter especially reduced. The pelvic pair arises at a point 0·11 distant from the origin of the pectorals and 0·145 from that of the anal. Only a few supports of the dorsal fin are shown, these being well in advance of the anal, which is much extended but not sufficiently well-preserved for the counting of the rays. The caudal fin is complete, exhibiting the very fine subdivision of the rays at its hinder border and a fringe of small fulcra on its anterior margins. The scales are smooth, but the majority probably exhibit only their inner face.

By exchange, 1893.

P. 7181. An equally large fish similarly displaying the axial skeleton of the trunk and the very fine tubercular ornament of some of the external bones; Eichstädt. The pelvic fins are displaced but well preserved, and the remains of the dorsal fin exhibit a fringe of small fulcra on its

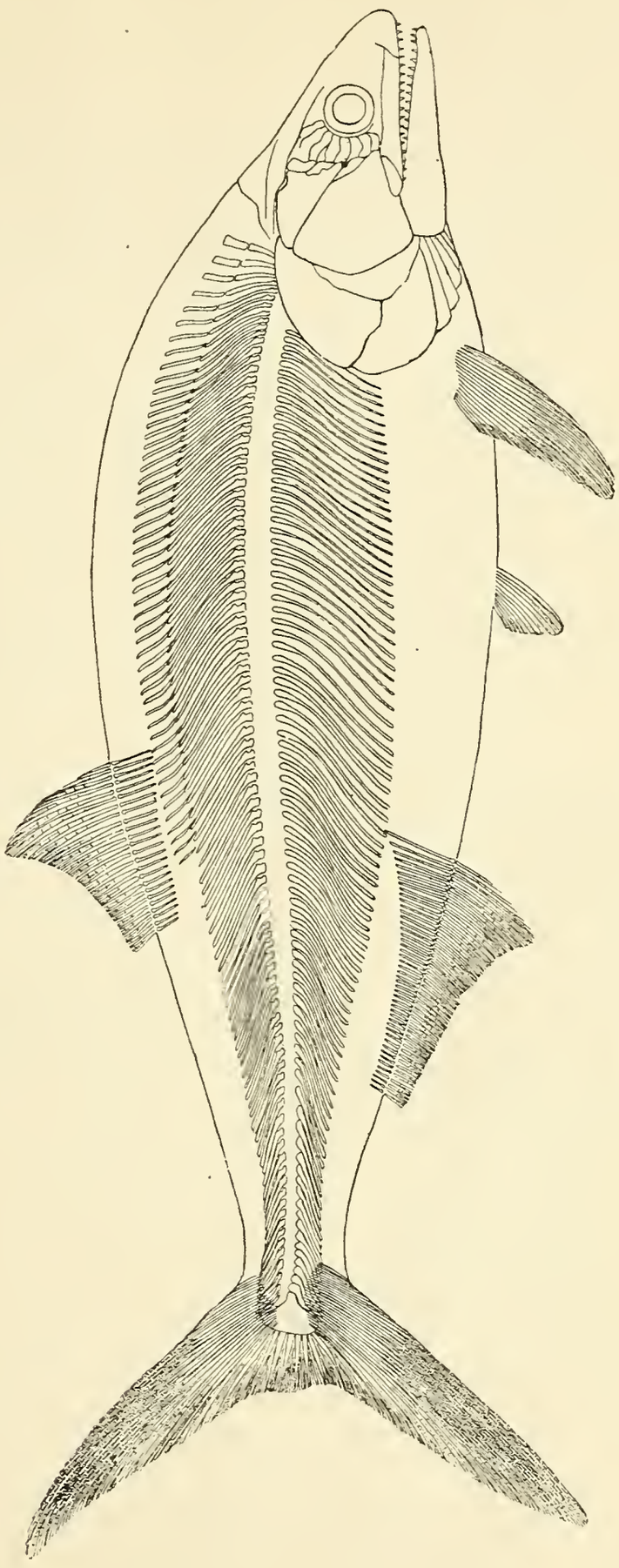


Fig. 40.

Hypsocormus insignis; restoration, squamation omitted.

anterior border. More than 40 supports of the anal fin are preserved, but the series is incomplete. Above the expanded hæmal at the base of the caudal fin there are indications of a series of robust supporting spines which also are probably hæmal. *By exchange*, 1894.

P. 954. Crushed remains of head and trunk; Solenhofen. The cranium is exposed from above, displaying the obtuse rostrum in front (Pl. XIV. figs. 1, 1 *a*) and much spar beneath the hinder portion. The mandibular dentition is also well shown. *Egerton Coll.*

P. 4236. Imperfect trunk with scattered squamation and displaced median fins; Solenhofen. The single expanded hæmal is well shown in position; and at the base of the upper lobe of the displaced caudal fin there is the series of robust supports noted in the last specimen. 44 supports of the anal fin remain, but the series is incomplete. The scales are shown to be rhombic, narrowed towards the ventral border, and all are smooth. *Enniskillen Coll.*

Hypsocormus macrodon (Wagner).

1858. *Strobilodus giganteus*, F. A. Quenstedt (*errore*), Der Jura, p. 808, pl. xcvii. fig. 12.
1858. *Eugnathus macrodon*, A. Wagner, Gesch. d. Urwelt, ed. 2, vol. ii. p. 471.
1863. *Eugnathus macrodon*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 671.
1883. *Strobilodus giganteus*, F. A. Quenstedt (*errore*), Handb. Petrefakt. ed. 3, p. 334, woodc. fig. 105.
1887. *Hypsocormus macrodon*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 226.

Type. Nearly complete fish; Palæontological Museum, Munich.

A large species, attaining a length of about 1·5. Head with opercular apparatus occupying about one-fifth of the total length to the base of the caudal fin. Snout short and obtuse, with large vomerine teeth directed almost vertically. External bones and anterior fin-rays tuberculated. Scales of the flank in part deeper than broad, those of the ventral aspect 3 or 4 times as broad as deep, all more or less finely tuberculated, many also with a few vertical striations near the anterior margin.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone); Bavaria and Würtemberg.

P. 954 and P. 4236 are counterparts.

1906. Hypsocormus macrodon, E. Heinecke, Geol. u. Paläeont. Abhandl. vol. xii. p. 189, pl. xxvi. fig. 1.

1914. Hypsocormus macrodon, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 416, pl. lxxi. figs. 1, 2.

P. 6011. A contorted specimen about 1·5 in length, showing the paired and caudal fins, noticed in Ann. Mag. Nat. Hist. [6] vol. xiii. 1894, p. 511; Solenhofen. The large triangular lower suborbital exhibits a few radiating fissures or grooves in its hinder half, and it seems to have been unornamented except at its superior and inferior borders. Eight of the characteristic posterior circumorbital plates are preserved, each finely rugose or tuberculated in front; while between this series and the two great suborbitals, there are three other irregular plates. The arrangement is shown in the restoration of *H. insignis*, fig. 40, p. 393. The two vomerine teeth are well-preserved. The ossified sclerotic is shown in section. 21 rays can be counted in the pectoral fins, all divided distally, and the anterior ones are finely tuberculated. The scales exhibit the superficial granulations most distinctly in the abdominal region, the vertical markings best in the caudal region.

Purchased, 1889.

Hypsocormus leedsi, A. S. Woodward.

[Plate XI. fig. 1.]

1889. *Hypsocormus leedsi*, A. S. Woodward, Geol. Mag. [3] vol. vi. p. 450.

Type. Remains of skull; British Museum.

An imperfectly known species about as large as *H. macrodon*. Snout obtusely pointed, the two sides meeting approximately in a right angle at its anterior termination, and the external surface finely granulated; the large pair of vomerine teeth inclined much forwards and apparently projecting out of the mouth.

Form. & Loc. Oxfordian: Huntingdonshire.

P. 6913. The type specimen, comprising rostrum, portion of splenial, the two post-frontals, and other fragments of cranium; Oxford Clay, near Peterborough. The inferior aspect of the rostrum (Pl. XI. fig. 1) exhibits the basal portion of the right vomerine tooth (*v.*) and the socket for that of the left side; while both of these are shown to be much directed forwards and the posterior wall of their socket is not ossified. Flanking each tooth externally there is a triangular area covered with small conical teeth fused with the supporting bone, only the apical portion of each enamelled; and two of the marginal teeth directly in front of the vomerine pair are much larger than the others.

The blunt anterior end of the rostrum, well shown in side-view (fig. 1 *a*), exhibits a slight mesial vertical ridge. There are some traces of closed sutures in the cranial roof, but the fragments are too imperfect for satisfactory determination. *Leeds Coll.*

P. 6914. Imperfect rostrum about half as large as the type, associated with the tooth-bearing border of the dentary bone; near Peterborough. Only the base of the left vomerine tooth is preserved; and instead of two enlarged marginal teeth anteriorly, there is but one. A transverse section of one of the large teeth of the dentary is prepared for microscopical examination, and exhibits the complex structure noted in Ann. Mag. Nat. Hist. [6] vol. xiii. (1894), p. 511. *Leeds Coll.*

P. 6915. Abraded large right splenial with remains of anterior end of dentary, probably of this species; near Peterborough. *Leeds Coll.*

P. 6833. Fragments of skull and pectoral fin probably of this species; near Peterborough. *Leeds Coll.*

Hypsocormus tenuirostris, A. S. Woodward.

[Plate XI. figs. 2–6.]

1889. *Hypsocormus tenuirostris,* A. S. Woodward, Geol. Mag. [3] vol. vi. p. 451.

Type. Remains of skull; British Museum.

An imperfectly known species about as large as *H. macrodon.* Snout acutely pointed and produced so that its length in advance of the large vomerine teeth somewhat exceeds its breadth at their insertion; external surface finely granulated; the large vomerine teeth directed almost vertically.

Form. & Loc. Oxfordian: Huntingdonshire.

P. 6916. The type specimen, comprising rostrum, right maxilla and premaxilla, portion of left dentary, and other associated fragments; Oxford Clay, near Peterborough. The rostrum (Pl. XI. figs. 2, 2 *a*) is comparatively narrow and acutely pointed, and there is a considerable extension in advance of the vomerine area (fig. 2, *v.a.*). The whole of the external surface is ornamented with fine tubercles. The two vomers seem to be fused into one bone, and the greater part of the large tooth of the right side is preserved, while the socket only of that on the left is exhibited.

A few teeth of variable size are arranged in a single irregular series on the margin of the vomerine area, the largest being three teeth on the right side. The premaxilla (figs. 3, 3 *a*, *pmx.*) is triangular in form and laterally compressed, with thickened alveolar border; and the upper margin of its inner face exhibits a long narrow facette (*f.*) for direct articulation with the cranium. The maxilla (figs. 3, 3 *a*, *mx.*) is long and slender and gently arched, and sends forwards a process (incomplete in this specimen) on the inner side of the premaxilla resting immediately above its thickened oral border (fig. 3 *a*, *p.*). Posteriorly the bone is imperfect, but there remains part of the rugose facette overlapped by the supramaxilla (fig. 3, *s.mx.*). The outer face of the maxilla, as also the lower portion of the outer face of the premaxilla, is ornamented with fine tuberculations like those of the rostrum; and the extreme outer margin of the alveolar border bears very minute teeth or pointed tubercles. The teeth of the maxilla are comparatively small and uniform, all well-spaced; while those of the premaxilla are much larger, closely arranged, and apparently largest in the middle of the bone. The dentary (fig. 4) is imperfect, only the thickened alveolar border being preserved, though this for the greater part of its length. The teeth are fused with the bone in sockets which are incomplete on the inner side; they are all well spaced, largest in the middle of the element, and considerably exceed the maxillary teeth in size. *Leeds Coll.*

P. 6917. Imperfect head and portions of fins of a typical fish; near Peterborough. The extremity of the rostrum is wanting, and the head is so much fractured that several interesting features in its osteology are exhibited. All the external bones are ornamented with very fine, closely-arranged tuberculations. The cranium is too much crushed for description; but a robust ossification is shown in the prefrontal region on the right side, and the greater part of the parasphenoid is also exposed. The latter element is considerably expanded in front and bears an elongate patch of minute granular teeth immediately in advance of the pair of foramina for the internal carotids. Among the remains of cheek-plates, some of the characteristic small circumorbitals are shown on the left side. The maxillæ (*mx.*) and premaxillæ (*pmx.*), similar to those of the last

specimen, are preserved on each side, though somewhat fractured, as shown in fig. 5; and part of the supra-maxillary plate (fig. 5, *s.mx.*) is also exhibited overlapping the hinder end of the maxilla. The anterior end of the alveolar border of the dentary bone of the mandible (fig. 5, *d.*) appears sinuous in side view, and the most anterior teeth, which are enlarged, are directed slightly forwards. Within the mouth remains of the pterygo-palatine arcade are observed above (fig. 5, *pt.*), but it is not possible to distinguish the elements; on its inner face there is a crowd of minute denticles (probably entopterygoid) which gradually become a little enlarged below, while on the oral margin (probably ectopterygoid and palatine) there are large teeth irregularly arranged and spaced, the largest being near the anterior end. When viewed from within, the dentary exhibits the usual thickened alveolar border, this in its hinder portion roofing the space occupied by the meckelian cartilage. The splenial element is also conspicuous, and may consist of more than one portion. As shown in a fragment from the left side a thickened, lenticular portion of this element (fig. 5 *a*, *spl.*) enters the mandibular symphysis, and bears at least one large tooth immediately behind the enlarged, forwardly pointing teeth of the anterior end of the dentary. Posteriorly on the inner face of the left mandibular ramus a thin laminar bone (fig. 5, *spl.*?), bearing minute granular teeth, is crushed upon the dentary in such a way as to suggest its forming the inner wall of the cavity for the meckelian cartilage. Another specimen still in Mr. Leeds' private collection exhibits the same plate continued forwards above in a long slender process; it is thus probably to be identified as a hinder splenial. There is nothing worthy of remark in the remains of the pectoral arch, but one of the pectoral fins (fig. 6) is interesting. The three foremost rays, successively increasing in length, are fused together, and their thickened proximal end (fig. 6 *a*) exhibits a hollowed, circular, articular facette (*f.*). The other rays are closely adpressed and unjointed so far as preserved, while their proximal ends simply clasp the basal cartilages. A few very fine tubercles ornament the sharp anterior border of the fin, and similar tubercles are observed on parts of the other rays. Among fragments

; also Nouv. Catal. Poiss. Form. Second. Boulonnais (1905), p. 14

Hypsocormus beaugrandi, H. E. Sauvage, Ann. Soc. Géol. Nord, vol. xxxiv (1905), p. 9. — U. Kimmeridgian; Châtillon, Boulogne-sur-Mer. [Parasphenoid fig? i Mém. Soc. Acad. Boulogne-sur-Mer, vol. ii. p. 47, pl. ii. fig. 16 (1867); Mus. Boulogne.]

Hypsocormus combesi, H. E. Sauvage,

U. Kimmeridgian; Fumel, Lot-et-Garonne.

Xenesthes velox, D. S. Jordan, Bull. Dept. Geol. Univ. Calif. vol. v (1907), p. 120, f. 16. — Trias; Shasta Co., Calif. ["Pnsx."; Univ. California.] Evidently not Pnsx.
= Birgeria Stensiö (q.v. p. 20. infra)

of the caudal fin the expanded supporting hæmal spine is conspicuous, and there is a slight longitudinal ridge on this bone where the rays of the upper and lower lobes diverge. A few uniserial fulcra are intercalated between the tips of the gradually lengthening rays on the anterior borders of the fin. All the scales preserved both behind the pectoral arch and at the origin of the caudal fin are ornamented with very fine tubercles. *Leeds Coll.*

P. 6920. Expanded hæmal arch from base of caudal fin either of this or the preceding species; near Peterborough. *Leeds Coll.*

The following specimens are not specifically determined:—

42368 a, 43028 a, P. 347 a. Five fragments of jaws of a small species, noticed in Geol. Mag. [3] vol. vi. 1889, p. 451; Kimmeridge Clay, Weymouth. *Purchased*, 1870, 1871, 1881.

P. 6918. Two very stout left maxillæ, more or less imperfect; Oxford Clay, near Peterborough. *Leeds Coll.*

36308. Expanded hæmal arch from base of caudal fin, associated with fragments of rays; Oxford Clay, Christian Malford, Wiltshire. *Purchased*, 1861.

Genus **PROTOSPHYRÆNA,** Leidy.

[Trans. Amer. Phil. Soc. vol. xi. 1857, p. 95.]

Syn. *Erisichthe,* E. D. Cope, Proc. Acad. Nat. Sci. Philad. 1872, p. 280.

Pelecopterus, E. D. Cope, Vert. Cret. Form. West. (Rep. U.S. Geol. Surv. Territ. vol. ii. 1875), p. 244 c.

An imperfectly definable genus known only by the head, pectoral arch, and pectoral fins, which are closely similar to the corresponding parts of *Hypsocormus*. Rostrum ordinarily much produced; premaxilla large and triangular in shape. Dentition powerful, all the principal teeth much compressed, with sharp anterior and posterior edges, and fixed in deep, complete sockets; those of the vomer, premaxilla, and splenial especially large, and similar teeth projecting forwards from the downwardly-curved anterior extremity of the oral border of the dentary; those of the maxilla and hinder portion of dentary comparatively small and in a single close series;

those of the pterygoid bones more or less granular. Gular plate present. Pectoral fins large and sickle-shaped, consisting of closely-apposed, unjointed and unbranched rays, of which the majority terminate successively at the oblique, trenchant anterior margin.

The teeth of this genus from European Cretaceous formations were originally referred by Agassiz (Poiss. Foss., Feuill. 1835, p. 55) in error to *Saurocephalus* of Harlan (Journ. Acad. Nat. Sci. Philad. vol. iii. 1824, p. 337); while the pectoral fins were wrongly described as fin-rays of *Ptychodus* (Agassiz, *ibid.* vol. iii. 1837, p. 56). The mistake in the identification of the teeth was first pointed out by Leidy (*loc. cit.* 1857), who, however, failed to recognize that the elongated rostrum belonged to the same fish as these fossils. The pectoral fin-rays were first proved to be not Elasmobranch by Cope (*loc. cit.* 1875), and their identity with *Protosphyræna* was subsequently determined both by Cope (in A. S. Woodward, Proc. Geol. Assoc. vol. x. 1888, p. 321) and by A. R. Crook (Palæontogr. vol. xxxix. 1892, p. 110). The best description of the head hitherto published is that by J. Felix (Zeitschr. deutsch. geol. Ges. vol. xlii. 1890, pp. 278–302, pls. xii.–xiv.); but neither Crook nor the present writer has observed any evidence of the so-called "praedentale" described by this author. The thickening of the alveolar border of the dentary bone is interpreted by Cope as an anomalous median element.

Protosphyræna ferox, Leidy.

1822. "Undetermined," G. A. Mantell, Foss. South Downs, p. 228, pl. xxxiii. figs. 7–9.

1835–44. *Saurocephalus lanciformis*, L. Agassiz (*errore*), Poiss. Foss., Feuill. p. 55, vol. v. pt. i. p. 102, pl. xxv. *c.* figs. 21–29.

1844. *Saurocephalus lanceolatus*, L. Agassiz, *ibid.* vol. v. pt. i. p. 8 (misprint).

1850. *Saurocephalus lanciformis*, F. Dixon, Geol. Sussex, p. 374, pl. xxx. fig. 21, pl. xxxi. fig. 12, pl. xxxii.* fig. 1, pl. xxxiv. fig. 11.

1857. *Protosphyræna ferox*, J. Leidy, Trans. Amer. Phil. Soc. vol. xi. p. 95.

1857. *Xiphias dixoni*, J. Leidy, *ibid.* p. 95. [Rostrum; British Museum.]

(?) 1860. *Saurocephalus lanciformis*, V. Kiprijanoff, Bull. Soc. Imp. Nat. Moscou, vol. xxxiii. pt. i. p. 666, pl. x. fig. 4.

1877. *Erisichthe dixoni*, E. D. Cope, Bull. U.S. Geol. Surv. Territ. vol. iii. p. 823.

1878. *Erisichthe dixoni*, W. Davies, Geol. Mag. [2] vol. v. p. 260, pl. viii. fig. 3.

1878. *Protosphyræna ferox*, E. T. Newton, Quart. Journ. Geol. Soc. vol. xxxiv. p. 789.

An imperfect skull of Protosphyraena penetrans from Kansas in Tübingen Univ. Mus. seems to show small & short occipital elevation, but not quite clear. [May 1912. A.S.W.]

For notochordal tail see C. E. McClung, Kansas Univ. Sci. Bull. vol. iv (1908), p. 245, pl. xiii.

P. sp. fm Palagonien D'Erasmo 1934 p. 14 pl. f. 7-8 ?.

Examined skull described by Dr. Felix May 9th. 1897 and could not recognise the "praedentale". Dr. Felix himself now thinks the determination doubtful. A.S.W.

1836. Saurocephalus lanciformis Mantell, descr. Cat. Mus. Sci. Lit. Inst. Lewes, 4th Ed. p. 30 (name).

1905. Protosphyraena ferox, A. Fritsch & F. Bayer, Neue Fische u. Rept. Böhm. Kreideform. p. 4, pl. i. figs. 2, 4, 5; text figs. 1-3. [Fragments from Bohemia.]

(?) 1896. *Protosphyraena ferox*, F. Priem, Bull. Soc. Géol. France [3] vol. xxiv. p. 17, pl. ii. f. 15, 16; p. 19, pl. ii. f. 17. [Teeth.]

(?) 1902. *Protosphyraena ferox*, M. Leriche, Ann. Soc. Géol. Nord, vol. xxxi. p. 132, pl. iv. figs. 4, 5. [Teeth.]

1908. *Protosphyraena ferox*, A. S. Woodward, Fos. Fishes English Chalk (Pal. Soc.), p. 147, pls. xxxi., xxxii, text-fig. 45.

(?) 1908. *Protosphyraena ferox*, F. Priem, Poiss. Foss. Bassin Parisien (Publ. Ann. Paléont.), p. 49, text-fig. 19. [Tooth, sp. ind., from Cenomanian, Sarthe, France.]

(?) 1930. *Protosphyraena ferox*, Palaeontographica ~~LXXII~~ LXXIII, Pl. xiv. f. 4. Senon^r: Quiriquina Is, Chile.

1929

Tooth from Groschowitz, Upper Silesia, referred to this species by R. Leonhard, Palaeontog. vol. xliv (1897), p. 69, pl. v. fig. 7.

P. 6529. Dext. 4 figs. A.S.W. 1908, p. 148, pl. xxxi. fig. 1.

P. 3955. Left mandibular ramus dext. 4 figs. A. S. W. 1908, p. 149, pl. xxxi. fig. 6.

1888. *Protosphyræna ferox*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 321.

1895. *Protosphyræna ferox*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 211, woodcut fig. 3.

Type. Teeth; British Museum.

The type species. Rostrum much elongated and attaining a length of about 0·3 with a transverse diameter of 0·05 at its base where the vomerine teeth are implanted; circular in transverse section throughout its whole length, except within a short distance of the vomerine teeth, where it becomes slightly flattened on the upper part of its sides and the top and passes into the gradually widening flattened cranial roof; its external surface ornamented with reticulating rugæ, of which the most prominent are longitudinally directed. Cranial roof more finely rugose and tuberculated. Teeth sometimes smooth, but usually with slight longitudinal wrinkles, which cause splits in the enamel of the fossils; the acute edges not serrated. Symphysial extremity of each dentary bearing three large teeth, and its oral border toothless where apposed to the dentigerous part of the splenial; splenial with two large teeth, and smaller teeth in front but none behind.

Form. & Loc. Senonian, Turonian, and Cenomanian: S.E. England. (?) Cenomanian: Kursk, Russia.

P. 6529. Very fine rostrum, measuring 0·28 from the vomerine teeth to its incomplete distal extremity, showing a fragment of the anterior part of the cranial roof and associated with pyritised remains of the anterior half of the right mandibular ramus; Lower Chalk, Blue Bell Hill, Burham, Kent. The internal cavity of the rostrum at its base is subdivided by a median vertical septum which is shown considerably in advance of the vomerine teeth; and the outer surface of the rostrum exhibits the characteristic ornamentation. The vomerine tooth of the right side is completely preserved, but on the left there is only the apex of what seems to be a successional tooth. Two of the much larger anteriorly-projecting teeth of the dentary are also exposed; and part of the series of diminutive teeth is preserved on its oral border behind the region of the splenial. *Presented by S. J. Hawkins, Esq.*, 1891.

P. 3955–56. A much abraded, fractured, and partially crushed rostrum, associated with the mandible and other fragments; Chalk, Kent. Only the right vomerine tooth is preserved, and the hollow portion of rostrum above it is

laterally compressed by accidental crushing. A sclerotic ring, showing some traces of rugosity, lies in the matrix beneath the fossil. The mandible wants its hinder extremity, and only the bases of the larger teeth remain. The outer face of the anterior end of the dentary is very coarsely rugose, and the symphysis is somewhat expanded for the sockets of the three anteriorly-directed large teeth. Of the latter on the left side the uppermost socket appears to be almost obliterated. There is no suture between the symphysial end and the remainder of the dentary bone, but it exhibits its usual slight constriction where flanking the splenial, and the oral border is toothless until a point considerably behind the dentigerous portion of the inner element. The teeth of its single, moderately spaced series are small and nearly equal in size, a diminution being shown only in the foremost five or six; the hindermost teeth, however, are not preserved. The middle portion of the dentary is about one-third deeper than its symphysial end, much thinner, and with the inferior margin slightly turning inwards. The splenials evidently enter the symphysis, but pyrites obscures their anterior end. Viewed from above each is lenticular in form, though produced in a very long and slender extension posteriorly; and the thickest portion on the left side exhibits the bases of two large teeth besides one small anterior tooth, while the corresponding part on the right side seems to indicate a diseased state of the bone. Fragments of other elements are displaced between the mandibular rami, but it is impossible to determine them. *Enniskillen Coll.*

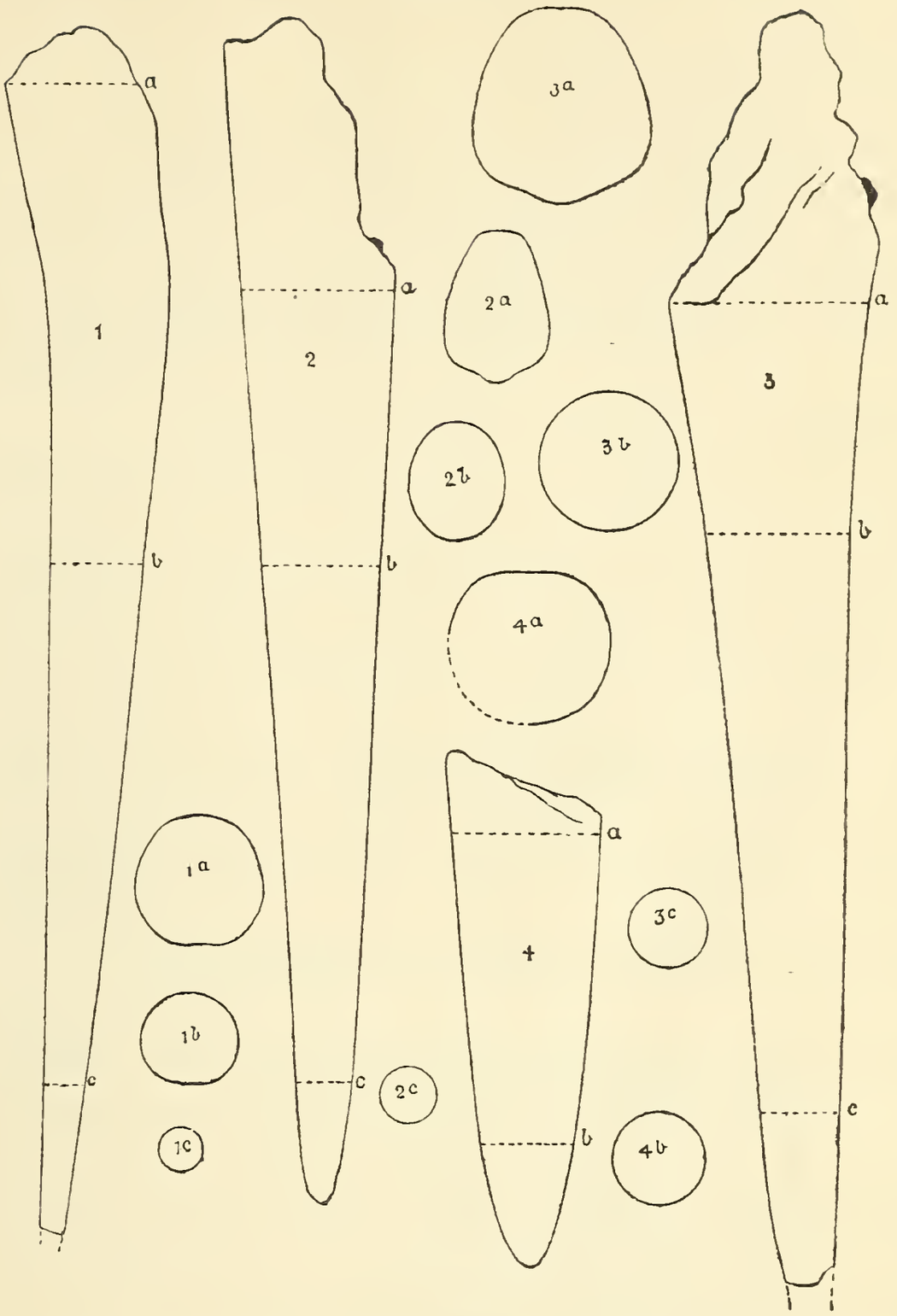
P. 5651. Fragments of skull in a block of chalk; Cuxton, Kent. A portion of the flattened cranial roof is rugose on the external surface, but affords no clue to the arrangement and limits of the elements. The imperfect parasphenoid is exposed from the inner aspect, showing the very robust though narrow bar beneath the orbit, and the much-extended laminar basipterygoid processes. There is also a fragment of a premaxilla with one tooth.

Harford Coll.

P. 5630. Fine rostrum, much fractured but displaying the superficial rugose ornament and the bases of the vomerine teeth, and apparently not distorted by crushing; Kent. A side view of this fossil is given in outline, of one-half

P.S-651. Noticed A.S.W. 1908, p. 148.

Fig. 41.



Outlines of Rostra of *Protosphyræna* in lateral aspect and transverse section, one-half natural size.

No. 1. *Protosphyræna tenuirostris*, A. S. Woodward.—Cambridge Greensand. [Woodwardian Museum, Cambridge.]

No. 2. *Protosphyræna compressirostris*, A. S. Woodward.—Kentish Chalk. [No. P. 5631.]

No. 3. *Protosphyræna ferox*, Leidy.—Kentish Chalk. [No. P. 5630.]

No. 4. *Protosphyræna keepingi*, A. S. Woodward.—Cambridge Greensand. [Woodwardian Museum, Cambridge.]

the natural size, in fig. 41, no. 3, three transverse sections being added in nos. 3 *a–c*. *Harford Coll.*

33254. Imperfect rostrum; English Chalk. *Taylor Coll.*

P. 612. Imperfect rostrum noticed and figured by Dixon, Geol. Sussex, p. 374, pl. xxxii.* fig. 1, under the name of *Saurocephalus lanciformis*, and termed *Xiphias dixoni* by Leidy, *loc. cit.*; Chalk, Kent. *Egerton Coll.*

P. 1801. Another imperfect rostrum showing the forward triangular extension of the flattened cranial roof; English Chalk. *Egerton Coll.*

33310. Fragment of rostrum; Chalk, Burham, Kent. *Purchased*, 1858.

49103. Crushed base of rostrum; English Chalk. *Mrs. Smith's Coll.*

49759. Fragment of rostrum; Chalk, Glynde, Lewes. *Capron Coll.*

35154. Imperfect rostrum, showing base of one vomerine tooth; Cambridge Greensand, Cambridge. *Purchased*, 1859.

P. 1802. Two fragments of distal end of rostrum; Cambridge Greensand. *Egerton Coll.*

35155. Imperfect base of rostrum; Cambridge Greensand. *Purchased*, 1859.

25709. Imperfect base of rostrum showing vomerine teeth, described and figured by W. Davies, Geol. Mag. [2] vol. v. p. 260, pl. viii. fig. 3; Chalk, Amberley, Sussex. *Dixon Coll.*

32747. Another fragment of base of rostrum showing vomerine tooth; Chalk, Burham. *Purchased*, 1857.

49012. Portion of right premaxilla, figured by Dixon, *op. cit.* pl. xxxiv. fig. 11; Chalk, Burham. *Mrs. Smith's Coll.*

P. 3954. Larger but more imperfect portion of premaxilla, showing six large teeth and one successional tooth; Chalk, Kent. *Enniskillen Coll.*

49820. Fragment of premaxilla; Chalk, Glynde. *Capron Coll.*

P. 5651. Right maxilla; Lower Chalk, Burham. *Harford Coll.*

43092. Portion of large left maxilla, des? & fig? A.S.W. 1908, p. 149, pl. xxxi. fig. 5; zone 4 Hd. subglobosus, Halling, Kent Wetherell Coll.

49012. Des? & fig? A.S.W. 1908, p. 148, pl. xxxi. fig. 2.

R 5651. Des? & fig? A.S.W. 1908, p. 149, pl. xxxi. fig. 4.

49827. Posterior splenial noticed A.S.W. 1908, p. 149.

39438. Des? & fig? A.S.W. 1908, p. 149, pl. xxxii. fig. 1.

P.5-634. Left premaxilla des? & fig? A.S.W. 1908, p. 148, pl xxxi. fig. 3.

P.65-30. Des? & fig? A.S.W. 1908, p. 150, pl. xxxi. fig. 7.

1908. Protosphyraena compressirostris, A.S. Woodward, Proc. Fishes English Chalk (Pal. Soc.), p. 152, text-fig. 45.

49827. Fragment apparently of dentary, associated with an inner bone displaying a finely granular dentition; Chalk, Amberley. *Capron Coll.*

39438. Anterior extremity of mandible, figured by Dixon, *op. cit.* pl. xxxi. fig. 12; Chalk, Kent. *Bowerbank Coll.*

49089. Two fragments of anterior extremity of dentary; Lower Chalk, Burham. *Mrs. Smith's Coll.*

49742. Fragment of dentigerous bone; Chalk, Amberley. *Capron Coll.*

P. 5633–34. Fragments of jaws; Lower Chalk, Burham. *Harford Coll.*

4088, 4089, 4096, 4135. Five teeth, the type specimens described and figured by Agassiz, *tom. cit.* p. 102, pl. xxv. *c.* figs. 21, 24, 27–29; Chalk, Lewes. *Mantell Coll.*

25751–52, 25754, 25834. Four teeth figured by Dixon, *op. cit.* pl. xxx. figs. 21 *a–d*; Chalk, Sussex. *Dixon Coll.*

25750, 25808. Two teeth; Chalk, Sussex. *Dixon Coll.*

49770. Four teeth; Chalk, Amberley. *Capron Coll.*

P. 4543. Large tooth in bone-fragment. *Enniskillen Coll.*

27033. Tooth; Lower Chalk, Guildford. *Purchased*, 1851.

38584, 47925. Two large teeth; Lower Chalk, Burham. *Purchased*, 1864, *and presented by Hon. Robert Marsham*, 1877.

P. 6530. Tooth in bone-fragment; Lower Chalk, Blue Bell Hill, Burham. *Presented by S. J. Hawkins, Esq.*, 1891.

33255. Two large teeth; Chalk, Kent. *Taylor Coll.*

39055. Fine tooth; English Chalk. *Bowerbank Coll.*

Protosphyræna compressirostris, A. S. Woodward.

1895. *Protosphyræna compressirostris*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 213, woodcut fig. 2.

Type. Rostrum; British Museum.

Rostrum much elongated and attaining a length of at least 0·19 with a transverse diameter of 0·02 at its base where the vomerine teeth are implanted; laterally compressed in its proximal half, the transverse section here being an oval with vertical long axis;

circular in transverse section in its distal portion; the top of the base gradually becoming flattened as it passes into the cranial roof. External ornament as in *P. ferox*.

Form. & Loc. Senonian: Kent.

P. 5631. The type specimen, a fractured rostrum showing the bases of the pair of vomerine teeth; Chalk, Kent. A diagrammatic outline of the left side-view of the fossil is shown of half the natural size in fig. 41, no. 2 (p. 403), and transverse sections are given *ibid.* nos. 2 *a–c*. *Harford Coll.*

Protosphyræna minor (Agassiz).

1837–44. *Tetrapterus minor*, L. Agassiz, Poiss. Foss. vol. v. pt. i. pp. 7, 91, pl. lx. *a*. figs. 9, 10 (*non* figs. 11–13).

1888. *Protosphyræna minor*, A. S. Woodward, Proc. Geol. Assoc. vol. x. p. 321.

1890. *Protosphyræna minor*, J. Felix, Zeitschr. deutsch. geol. Ges. vol. xlii. p. 299.

Type. Fragment of rostrum; British Museum.

Rostrum comparatively delicate and much elongated, attaining a length of at least 0·15; the transverse section a depressed oval throughout its length, and the internal cavity extending a considerable distance towards the gradually tapering end; the external surface ornamented with coarse, closely-arranged, parallel longitudinal ridges, and its upper aspect marked with a median longitudinal groove which does not obliterate the ornamentation.

No portion of this fish except the rostrum has hitherto been identified.

Form. & Loc. Turonian: Kent and Sussex.

4078. Fragment of rostrum described and figured by Agassiz, *loc. cit.*; Chalk, Lewes. The extremity of the fossil was missing when received by the Museum. *Mantell Coll.*

49758. Larger portion of a similar rostrum, much fractured; Grey Chalk, Lewes. *Capron Coll.*

49100. Another crushed and broken specimen, displaying the large internal cavity and the superficial ornamentation; probably from the Lower Chalk of Burham, Kent. *Mrs. Smith's Coll.*

32337. Distal end of rostrum, displaying ornament and apparently worn towards the extremity; Lower Chalk, Burham. The ridged ornament is more irregular on the inferior than on the superior aspect. *Purchased*, 1857.

1909. Protosphyraena minor, A.S. Woodward, Jour. Fisher. English Chalk (Pal. Soc.), p. 153, pl. xxxiii. fig. 1, 2.

49100. Ornament des? d figd A.S.W. 1909, p. 153, pl. xxxiii. fig. 2.

32337. Desd d figd A.S.W. 1909, p. 153, pl. xxxiii. fig. 1.

Protosphyræna tenuirostris, A. S. Woodward.

1860. *Saurocephalus striatus*, V. Kiprijanoff (*errore*), Bull. Soc. Imp. Nat. Moscou, vol. xxxiii. pt. i. p. 666, pl. x. fig. 3.

1895. *Protosphyræna tenuirostris*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 211, woodc. fig. 1.

Type. Rostrum ; Woodwardian Museum, Cambridge.

Rostrum much elongated and slender, somewhat flexed upwards shortly in advance of the vomerine teeth, and attaining a length of about 0·24 with a transverse diameter of 0·027 at its base where the vomerine teeth are implanted ; transverse section remarkably cylindroidal throughout its length, slightly depressed in its middle portion ; external surface marked by fine longitudinal ridges.

A diagrammatic outline of the left side-view of the type specimen is shown of half the natural size in fig. 41, no. 1 (p. 403), and transverse sections are given, *ibid.* nos. 1 *a–c*. The Russian specimen described by Kiprijanoff is slightly more attenuated.

Form. & Loc. Cenomanian (Cambridge Greensand): Cambridgeshire ; Kursk, Russia.

Not represented in the Collection.

Protosphyræna keepingi, A. S. Woodward.

1895. *Protosphyræna keepingi*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 212, woodcut fig. 4.

Type. Portion of rostrum ; Woodwardian Museum, Cambridge.

Rostrum remarkably stout and short, circular in transverse section, only slightly flattened on the top at its base ; external surface ornamented with reticulating rugæ.

A diagrammatic outline of the left side-view of the type specimen is shown of half the natural size in fig. 41, no. 4 (p. 403), and transverse sections are given, *ibid.* nos. 4 *a*, *b*.

Form. & Loc. Cenomanian (Cambridge Greensand) ; Cambridgeshire.

Not represented in the Collection.

Protosphyræna ornata, A. S. Woodward.

1895. *Protosphyræna ornata*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 212, pl. viii. fig. 7.

Type. Imperfect rostrum ; Woodwardian Museum, Cambridge.

Rostrum much elongated and attaining a length of about 0·2 with a transverse diameter probably of 0·02 or 0·025 at its base where the vomerine teeth are implanted ; vomerine area elongated,

and the rostrum much laterally compressed, except towards its attenuated distal extremity which is round in section. The rounded upper contour of the rostrum gradually becoming raised into an obtuse median longitudinal ridge at its base and ornamented with coarse rugæ, which frequently subdivide into tubercles and are mainly longitudinal in direction though partly turned obliquely downwards; the lateral portions ornamented with much finer longitudinal rugæ which in part tend to converge at the middle of the side, and form a slight median longitudinal ridge on the inferior aspect of the rostrum for some distance in advance of the vomerine area.

Form. & Loc. Cenomanian (Cambridge Greensand): Cambridgeshire.

P. 7248. Uncrushed fragment of base of rostrum, displaying the upper contour and ornamentation, the pair of ethmoidal canals, and part of the vomerine area. *Jesson Coll.*

P. 7246–47. Five typical fragments of rostrum. *Jesson Coll.*

Protosphyræna brevirostris, A. S. Woodward.

1895. *Protosphyræna brevirostris*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 212, pl. viii. fig. 9.

Type. Imperfect rostrum; British Museum.

Rostrum comparatively short and acute, its length apparently not exceeding 0·05 in a specimen measuring 0·025 in transverse diameter where the vomerine teeth are implanted. Upper aspect of rostrum flattened and the sides converging below in a median inferior keel, making the transverse section triangular at the end of the vomerine region; surface nearly smooth.

Form. & Loc. Cenomanian (Cambridge Greensand): Cambridgeshire.

P. 7253. Type specimen described and figured, *loc. cit.* *Jesson Coll.*

P. 7252. A more abraded rostrum, with a slightly larger and longer extension, imperfect at the extremity but exhibiting a flattened triangular area immediately in front of the vomerine teeth, noticed *ibid.* p. 214. *Jesson Coll.*

Protosphyræna depressa, A. S. Woodward.

1895. *Protosphyræna depressa*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 212, pl. viii. fig. 8.

Type. Imperfect rostrum; Woodwardian Museum, Cambridge.

Rostrum comparatively short and depressed, its length apparently

1912. Protosphyraena stebbingi, A.S. Woodward, The Naturalist, p. 329, pl. xix.

Protosphyraena stebbingi, A.S.W.

1909. Protosphyraena stebbingi, A.S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 153, pl. xxxiii. fig. 3.

Syn. Portions of rostrum; W. P. D. Stebbing Coll.

Loc. Zone of Hol. subglobosus; Betchworth, Surrey; near Rochester, Kent (Rochester Mus.); South Ferriby, Lincolnshire.

1900. Protosphyraena nitida, F. B. Loomis, Palaeontogr. vol. xlvi. p. 227, pl. xix. f. 6, 7.

1903. Protosphyraena nitida, O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix. p. 3, text-figs. 1-3.

1908. Protosphyraena nitida, L. Hussakof, Bull. Amer. Mus. Nat. Hist. vol. xxv. p. 93, fig. 48B.

1900. Protosphyraena penetrans, F. B. Loomis, Palaeontogr. vol. xlvi. p. 224, pl. xix. f. 1-5.

not exceeding 0·055 in a specimen measuring 0·025 in transverse diameter where the vomerine teeth are implanted. Upper aspect of rostrum flattened, almost hollowed, the sides converging below so that the transverse section appears triangular with rounded angles; surface smooth or in part slightly rugose.

Form. & Loc. Cenomanian (Cambridge Greensand); Cambridgeshire.

Not represented in the Collection.

Protosphyræna nitida (Cope).

1872. *Erisichthe nitida*, E. D. Cope, Proc. Acad. Nat. Sci. Philad. p. 281.
1874. *Erisichthe nitida*, E. D. Cope, Bull. U. S. Geol. Surv. Territ. vol. i. no. 2, p. 42.
1875. *Erisichthe nitida*, E. D. Cope, Vert. Cret. Form. West (Rep. U.S. Geol. Surv. Territ. vol. ii.), p. 217, pl. xlviii. figs. 3–8.
1877. *Erisichthe nitida*, E. D. Cope, Bull. U.S. Geol. Surv. Territ. vol. iii. p. 821.
1890. *Protosphyræna nitida*, J. Felix, Zeitschr. deutsch. geol. Ges. vol. xlii. p. 278, pls. xii., xiii., pl. xiv. figs. 2–7.
1892. *Protosphyræna nitida*, A. R. Crook, Palæontogr. vol. xxxix. p. 110.

Type. Portions of skull; Amer. Mus. Nat. Hist.

The type species of the so-called genus *Erisichthe*. Rostrum much elongated, slightly recurved, and attaining a length of about 0·155 with a transverse diameter of 0·025 at its base where the vomerine teeth are implanted; flattened above in its distal half, the transverse section in this region is semicircular, a strong angle on each side limiting the superior plane, while the section at the base of the rostrum is a transverse oval; the flattened upper surface finely rugose, the remainder ornamented with closely arranged longitudinal ridges, in part reticulated.

Form. & Loc. Upper Cretaceous (Niobrara Group): Kansas, U.S.A.

Not represented in the Collection.

Protosphyræna penetrans (Cope).

1877. *Erisichthe penetrans*, E. D. Cope, Bull. U.S. Geol. Surv. Territ. vol. iii. p. 822.
1890. *Protosphyræna penetrans*, J. Felix, Zeitschr. deutsch. geol. Ges. vol. xlii. p. 297, pl. xiv. fig. 1.
1892. *Protosphyræna penetrans*, A. R. Crook, Palæontogr. vol. xxxix. p. 109.

Type. Rostrum.

Rostrum much elongated and attaining a length of about 0·15

with a transverse diameter of 0·035 at its base where the vomerine teeth are implanted, but more slender than the rostrum of *P. nitida*; transverse section a depressed oval throughout; surface ornamented with conspicuous longitudinal rugæ, in part reticulated.

Form. & Loc. Upper Cretaceous (Niobrara Group): Kansas, U.S.A.

Not represented in the Collection.

The following specimens of *Protosphyræna* are not specifically determined :—

40395. Imperfect, abraded rostrum, much elongated and either depressed or compressed; Chalk, Burham, Kent.
Purchased, 1867.

47291. Imperfect, crushed rostrum, much elongated and depressed, exhibiting remains of an external ornament of fine longitudinal rugæ; Grey Chalk, Dover. *Gardner Coll.*

P. 7243–44. Nine jaw-fragments; Cambridge Greensand, Cambridge. *Jesson Coll.*

P. 1796. Fragment of premaxilla; Gault, Barnwell, near Cambridge. *Egerton Coll.*

30258, 35131, 35437, 40356. Teeth; Cambridge Greensand.
Purchased, 1855, 1859, 1867.

47961. Five teeth; Cambridge Greensand.
Presented by Hon. Robert Marsham, 1877.

P. 7245. Three imperfect large teeth; Cambridge Greensand.
Jesson Coll.

32392. Tooth; Upper Greensand, Kilmerton, Isle of Wight.
Purchased, 1857.

35675. Tooth; Red Chalk, Speeton, Yorkshire. *Bean Coll.*

47225. Ten teeth; Gault, Folkestone. *Gardner Coll.*

36111. Tooth; Grey Chalk, Dover. *Purchased*, 1861.

P. 406. Tooth; Grey Chalk, Dover.
Presented by the Earl of Ducie, 1881.

47247. Three teeth; Chalk Marl, Dover. *Gardner Coll.*

35160a. Desc. & fig. A.S. Woodward, Fos. Fishes English Chalk (Pal. Soc. 1908), p. 150, pl. xxxii. fig. 3.

P.12911. Hypural; Niobrara Chalk, Gove Co., Kansas, U.S.A. H. T. Martin Coll.

P.1483. Desc. & fig. A.S. Woodward, Fos. Fishes English Chalk (Pal. Soc. 1908), p. 150, pl. xxxii. fig. 2.

P.4507a. Base of pectoral fin, foremost basecost noticed A.S.W. 1908, p. 150.

P. 7257. Four expanded hæmal bones doubtfully ascribed to this genus; Cambridge Greensand. *Jesson Coll.*

P. 7258. Ten expanded hæmal bones doubtfully ascribed to this genus, deeper than the preceding specimens and some exhibiting feeble vertical flutings; Cambridge Greensand. *Jesson Coll.*

30259, 35160, 35394. Eight expanded hæmals; Cambridge Greensand. *Purchased*, 1855, 1859.

P. 7256. Other still more deeply expanded hæmals of the form provisionally ascribed to this genus by W. Davies, Geol. Mag. [2] vol. v. p. 256; Cambridge Greensand. *Jesson Coll.*

35160 a, 35351. Two similarly expanded hæmals, imperfect but displaying slight vertical furrows; Cambridge Greensand. *Purchased*, 1859.

47191, P. 38. Two small expanded hæmals of similar form; Gault, Folkestone. *Gardner Coll.*

49102. Imperfect large example of similarly expanded hæmal 0·125 in depth; Chalk, Kent. *Mrs. Smith's Coll.*

38027. Smaller specimen; Chalk, Lewes. *Purchased*, 1863.

P. 5120. Still smaller specimen; Neocomian, Choroskowo, Russia. *Purchased*, 1886.

P. 1483. Small expanded hæmal overlapped by caudal fin-rays; Chalk, Sussex. *Egerton Coll.*

4074, 4099. Two fragments of pectoral fins showing wavy anterior border, described and figured by Agassiz (Poiss. Foss. vol. iii. 1837, p. 57, pl. x. *a*. figs. 1, 3) under the name of *Ptychodus spectabilis*; Upper Chalk, Lewes. The first specimen is also figured by Mantell (Geol. Sussex, 1822, pl. xxxix.) as "a dorsal fin, or *radius*, of a fish allied to the genus Balistes." *Mantell Coll.*

39471. Larger portion of a similar fin; English Chalk. *Bowerbank Coll.*

35374. Small fragment of similar fin; Chalk, Cambridge. *Purchased*, 1859.

41079. Another fine specimen of the anterior border of the pectoral fin; Chalk, Merstham, Surrey.
Presented by Prof. N. S. Maskelyne, 1868.

35554. Anterior portion of similar fin; Gault, Folkestone.
Purchased, 1859.

46961. Fragment of still larger pectoral; Lower Chalk, Burham, Kent. *Purchased*, 1876.

P. 1480. Two fragments of similar fin; Chalk, Lewes.
Egerton Coll.

4070. Fragment with more widely spaced anterior eminences, described and figured by Agassiz (*op. cit.* vol. iii. p. 58, pl. x. *a.* fig. 2) under the name of *Ptychodus arcuatus*, and also figured by Mantell (*op. cit.* pl. xl. fig. 3); Upper Chalk, Lewes. *Mantell Coll.*

P. 7254–55. Small fragments apparently of similar fins; Cambridge Greensand. *Jesson Coll.*

4075. Anterior portion of more delicate pectoral fin, with less prominently sinuous margin, described and figured by Agassiz (*op. cit.* p. 58, pl. x. *a.* fig. 4) under the name of *Ptychodus gibberulus*; Chalk, Lewes. *Mantell Coll.*

49747–48. Two fragments of similar fins; Lower Chalk, Southeram, Lewes. *Capron Coll.*

41695. Fine fin showing a basal bone; Chalk, Kent.
Toulmin Smith Coll.

39066. Similar but more imperfect fin; Chalk, Harisham, Kent.
Bowerbank Coll.

33176. Two fragments of similar fin; Chalk, Burham.
Purchased, 1857.

36092–93, 47280. Three imperfect specimens of similar fin; Lower Chalk, Dorking, Surrey.
Purchased, 1861, *and Gardner Coll.*

49733. Fine fin and another small specimen; Dorking.
Capron Coll.

49029–30. Two similar specimens; English Chalk.
Mrs. Smith's Coll.

41079. Des? & fig? A.S.W. 1908, p. 150, pl xxxii. fig. 4.

41695. Des? & fig? A.S.W. 1908, p. 150, pl xxxii. fig. 5.

P. 7573. Descr. & figd. A. S. Woodward, Fos. Fishes English Chalk (Pal. Soc. 1908), p. 150, pl. xxxii. fig. 6.

†*Martinichthys* **gen. n.**, *acutus* p. 25 pl. i, fig. 5, 6, *alternatus* p. 26 pl. i fig. 2, *brevis* p. 21 pl. i fig. 10 pl. ii figs. 11–17, *gracilis* p. 26 pl. i fig. 3, *intermedius* p. 26 pl. i fig. 1, *latus* p. 26 pl. i fig. 4 **spp. n.** Cretaceous Kansas, McCLUNG Proc. Amer. Phil. Soc. Philadelphia **65**. 5 suppl. Skull (brevis) + rostra: Pal. Mus. Univ. Kansas.

See also IV. p. 204

Enchodus libycus, W. Weiler, 1930, p. 29, pl. iii. f. 48-52, - pl. iv. f. 1 (teeth, probably not of this genus, from U. Cretaceous, Libyan Desert, are named *Protosphyraena libyca* (with vars. *anceps*, *incurva*, *mordax*), A. Quaas (ex Zittel MS.), Palaeontogr. vol. xxx (1902), p. 315, pl. xxviii. figs. 2-8. ?*Protosphyraena* W. Weiler, 1930, p. 27), pl. iii. ff. 37-41. E. L. M. Gigant 1951 Mus. Hist. Nat. P.R.F. Marc. 86, p. 134-17, Madrid. Mus.

Protosphyraena ventonia, A. Stewart, Kansas Univ. Quarterly, vol. vii (1898), p. 27, pl. i. f. 2. Cretaceous (Lincoln Marble); Rock Creek, Mitchell Co., Kansas. [Rostrum, &c.; Kansas Univ.]

Protosphyraena gigas, A. Stewart, ibid. vol. viii (1899), p. 110. – Cretaceous (Lisbon Shales); Lisbon, Logan Co., Kansas. [Fin; Kansas Univ.]

P. 1482 a. Another similar specimen; English Chalk. *Egerton Coll.*

25846. Fragment of fin; Chalk, Sussex. *Dixon Coll.*

49817. Another small fragment; Chalk, Amberley. *Capron Coll.*

The following specimens are more doubtfully assigned to *Protosphyræna*:—

4077. Anterior portion of fin described and figured by Agassiz (*op. cit.* vol. iii. p. 59, pl. x. *b*. fig. 18) under the name of *Ptychodus*; Chalk, Lewes. *Mantell Coll.*

25846 a. Fragment figured as *Ptychodus* in Dixon's Geol. Sussex, pl. xxxi. fig. 14; Chalk, Sussex. *Dixon Coll.*

P. 7573. Very imperfect pectoral fin showing seven basals and other bones; English Chalk. *History unknown.*

The so-called *Ptychodus articulatus*, Agassiz (*op. cit.* vol. iii. p. 58, pl. x. *a*. figs. 5, 6) seems to be a fragment of the caudal fin of *Portheus* or an allied fish. The appearance of a wavy margin given in Agassiz's figure is imaginary.

The following specimen probably belongs to the family Pachycormidæ, if not to the genus *Protosphyræna* itself:—

49531. Middle portion of caudal region noticed in Ann. Mag. Nat. Hist. [6] vol. xiii. (1894), p. 512; Upper Cretaceous, Sahel-el-Alma, Mt. Lebanon. There are no traces of vertebral centra, but the arches are very numerous and well ossified, somewhat expanded at the base. Remains of a dorsal fin occur in advance of a smaller anal. Fossilized remains of the muscular fibres are also conspicuous. *Lewis Coll.*

Martinichthys ziphioides, C.E. McClung loc. cit. p. 22. pl. 1. figs. 7-9.

An imperfect and abraded rostrum from the Cretaceous (Niobrara Group) of Kansas is also referred to this genus under the name of *Erisichthe ziphioides* by E. D. Cope, Bull. U.S. Geol. Surv. Territ. vol. iii. (1877), p. 823. Fragments of jaws from the Cretaceous of North Carolina are provisionally placed here (*Portheus angulatus*, E. D. Cope, Proc. Acad. Nat. Sci. Philad. 1872, p. 281, and in Kerr's Rep. Geol. Surv. N. Carolina, 1875, Append. B, p. 32; *Erisichthe angulata*, E. D. Cope, Vert. Cret. Form. West, 1875, p. 275). Protosphyræna? angulata, L. Hussakof, Bull. Amer. Mus. N.H. vol. xxv (1908), p. 92, fig. 47.

Pectoral fins of undetermined species of *Protosphyræna* were

Protosphyræna ziphioides, O.P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix (1903), text-figs. 13, 14; L. Hussakof, loc. cit. xxv (1908), p. 95, fig. 48 A.

originally regarded by Cope (*loc. cit.* 1875, p. 244 A) as representing a previously unknown order of Actinopterygian fishes, named Actinochiri. The American specimens are described as exhibiting "six single and one paired basilar bones supporting the pectoral fin, and all articulating with the scapula." The following forms, not represented in the Collection, are distinguished :—

Pelecopterus chirurgus, E. D. Cope, Vert. Cret. Form. West (Rep. U.S. Geol. Surv. Territ. vol. ii. 1875), p. 244 E, woodc. fig. 10, pl. xlviii. fig. 1, pl. liv. fig. 9.—Upper Cretaceous (Niobrara Group); Kansas.

Pelecopterus gladius, E. D. Cope, *loc. cit.* (1875), p. 244 E, pl. lii. fig. 3, pl. xliv. fig. 12: *Portheus gladius*, E. D. Cope, Proc. Acad. Nat. Sci. Philad. 1873, p. 338, and Bull. U.S. Geol. Surv. Territ. vol. i. no. 2 (1874), p. 40.—Ibid. A.M.N.H.

Pelecopterus perniciosus, E. D. Cope, *loc. cit.* (1875), p. 244 D, pl. xlviii. fig. 2, pl. lii. fig. 2, pl. xliv. fig. 13: *Ichthyodectes perniciosus*, E. D. Cope, Bull. U.S. Geol. Surv. Territ. vol. i. no. 2 (1874), p. 41.—Ibid. [The type species of *Pelecopterus*, referred to *Protosphyræna nitida* by A. R. Crook, Palæontogr. vol. xxxix. (1892), p. 110.]

Amer. Mus. N.H.

To the Pachycormidæ may also perhaps be referred the large problematical fish from the Oxford Clay of Peterborough named *Leedsia problematica* (A. S. Woodward, Geol. Mag. [3] vol. vi. 1889, p. 451 [*Leedsichthys problematicus*], and *ibid.* vol. vii. 1890, p. 292, pl. x. figs. 9, 10). The type specimens from the Leeds Collection are now preserved in the Museum, but the determination of all the bones except the gill-rakers (? or gill-supports) is still so uncertain, that it seems advisable to postpone the description of them until the final Supplement, when more satisfactory evidence of their true nature may perhaps be forthcoming. The massive bones, which have been compared with branchiostegal rays, will most likely prove to be vertebral arches. The genus also occurs in the Oxford Clay of Vaches Noires, Normandy, and in the Kimmeridge Clay of Dorsetshire.

Protosphyraena recurvirostris, A. Stewart, Kansas Univ. Quart. [A] vol. vii (1898), p. 191, woodc. — U. Cretaceous (Niobrara); Gove Co., Kansas. [Rostrum; Univ. Kansas.]

Protosphyraena obliquidens, F. B. Loomis, Palaeontogr. vol. xlvi. (1900), p. 225, pl. xx. figs. 1-4. — U. Cret.; Kansas. [Rostrum; Pal. Inst. Munich.]

" tenuis, F. B. Loomis, ibid. p. 226, pl. xx. f. 5-7. — Ditto. [Ditto.]

Prot. gladius, O. P. Hay, Bull. Amer. Mus. N. H. vol. xix (1903), p. 24.

P. perniciosa, O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix (1903), p. 9, pl. i. fig. 1, text-figs. 4-7.

P. 10340. Pectoral cest and pair of pectoral fins, one fig.? A. S. Woodward, Foss. Fishes English Chalk (Pal. Soc. 1908), p. 146, text-fig. 43; Niobrara Group, Kansas. Sternberg Coll.

Protosphyraena tenuis, F. B. Loomis, Palaeontogr. vol. xlvi (1900), p. 226, pl. xx. figs. 5-7; O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix (1903), p. 14, pl. i. figs. 2, 3.

Protosphyraena dimidiata, O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix (1903), p. 16, text-figs. 8-12. Erisichthe dimidiata, E. D. Cope, Proc. Amer. Assoc. Adv. Sci. vol. xxvi (1878), p. 300.

Protosphyraena sequax, O. P. Hay, Bull. Amer. Mus. Nat. Hist. vol. xix (1903), p. 20

[Authority for Rhinodon 70 ft. in length, see E. Percival Wright, "Six Months at the Seychelles," 1868. In vol. of Tracts on Radiata, &c., vol. 4, no. 24: Zool. Dept. 27. d. 29.]

Fragment of fin of *Protosphyraena* from Senonian of Vicenza: G. D'Erasmo, Cat. dl. Pesci Foss. d. Tre Venezie (Mem. Lab. Geol. R. Univ. Padova, vol. vi.), p. 62, pl. vi. fig. 17.

? *Platysomus petruchensis* s. n. 1946, C. Rusc
Not. prel. bis. geol. Min. R. de S. no 32 8 pp. 1 pl.
[Mand. r Scales: Mendoza Mus. J. U. Jur. (Tithon.) Argentina.

Suborder III. *AETHEOSPONDYLI.*

Notochord varying in persistence, but pleurocentra and hypocentra usually fused, never forming alternating discs or rings; tail abbreviate-heterocercal or homocercal. Mandible complex, with well-developed splenial rising into a coronoid process, which is completed by a distinct coronoid bone. Infraclavicular plates wanting in the pectoral arch; pectoral fin with more than five basals. Scales ganoid. In the living forms—air-bladder connected with the œsophagus in the adult, optic nerves not decussating, but forming a chiasma, and intestine with remnants of a spiral valve.

Synopsis of Families.

A distinct presymphysial bone in mandible; vertebral centra annular or amphicœlous; fin-fulcra minute or absent	ASPIDORHYNCHIDÆ (p. 415).
No presymphysial bone; vertebral centra opisthocœlous; fin-fulcra large	LEPIDOSTEIDÆ (p. 440).

Family ASPIDORHYNCHIDÆ.

Head and trunk much elongated, the snout produced, and the abdominal much longer than the caudal region; tail homocercal. Cranial and facial bones robust and opercular apparatus complete, all more or less ganoid; mandibular suspensorium vertical or inclined forwards, but gape of mouth wide; a distinct azygous presymphysial bone present in mandible; marginal teeth slender, conical. Branchiostegal rays numerous. Vertebral centra annular or amphicœlous. Fins small, with broad flattened rays, branched and articulated distally; fulcra minute or absent. Scales rhombic, much deepened on the flank.

Synopsis of Genera.

Rostrum much produced in advance of mandibular symphysis; an intercalary cheek-plate between the suborbitals and preoperculum; foremost scales of lateral line not deeper than those immediately beneath	*Aspidorhynchus* (p. 416).
Rostrum scarcely if at all produced in advance of mandibular symphysis; suborbitals in contact with preoperculum; all scales of lateral line deeper than those immediately beneath	*Belonostomus* (p. 428).

Genus **ASPIDORHYNCHUS,** Agassiz.

[Poiss. Foss. vol. ii. pt. i. 1833, p. 14.]

Rostrum slender, much produced in advance of mandibular symphysis; circumorbital plates very small, suborbitals large, and an intercalary plate between the latter and the preoperculum; teeth irregular in size, largest on the premaxilla, palatine, and presymphysial bone, reduced to a fine granulation on the inner face of the ectopterygoid; branchiostegal rays short and broad, and gular plate apparently absent. Vertebral centra annular. Fulcra wanting on paired fins, minute on median fins. Pelvic fins situated at about the middle of the trunk; dorsal and anal fins short-based, triangular, remote and opposed; caudal fin symmetrically forked. Scales robust, smooth or rugose; in three deepened series on the flank of the abdominal region, and the foremost scales of the series traversed by the lateral line not deeper than the series below.

The chondrocranium of *Aspidorhynchus* must have been considerably ossified, but its characters are as yet unknown. The cranial roof-bones form a continuous shield, and the frontals constitute much the largest portion of it; the whole of the roof is more or less rugose externally, and the median suture between the frontals is remarkably wavy. The parasphenoid is narrow and delicate, parallel with the hinder portion of the cranial roof, and apparently destitute of teeth. The elongated though robust vomers meet in an acute angle below the mesethmoid, and are firmly fused with the latter; they are likewise toothless, so far as the present writer has been able to observe them. The rostrum appears to be simple, but is often marked with longitudinal ridges which may readily be mistaken for separate elements in crushed specimens. The hyomandibular is much expanded, with a large process for the support of the operculum; and immediately behind the fan-shaped quadrate element there is a small narrow symplectic, widest at its upper end. The ectopterygoid is toothless behind, where it exhibits a moderately deep expansion, but bears further forwards a closely-set series of slender teeth, which gradually increase in size to its anterior extremity where it articulates with the palatine. The teeth on the latter element are largest behind and diminish forwards. The entopterygoid is long and narrow, while both this and the imperfectly-known metapterygoid are delicate. The epihyal is small and the ceratohyal very large, but the basihyal is unknown. The maxilla is much elongated and slender, bearing a series of relatively small teeth; and there is a curious laminar expansion along its upper border immediately in advance of the orbit. There are also

Cranium of Aspidorhynchus, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 96, text-fig. 33. [P. 9843-44. Two imperfect skulls of undetermined species; Great Oolite, Kingsthorpe, Northampton. J. Lesson Coll.]

511. Rayner 1941, Biol. Rev. 16 p. 235 ff. 12E-1948. Phil. Tr. R.S. 233B p. 314 figs 19. 23 pl. 21 f. 41-43.

some indications of a short supramaxilla above its hinder end. The premaxilla is also much elongated, with relatively large and spaced teeth posteriorly diminishing to minute teeth forwards; it is fused with the ethmoidal region, but does not meet its fellow of the opposite side in front, the groove between this pair of bones being continued for some distance along the base of the rostrum. Two relatively large plates of the suborbital series occupy the greater portion of the cheek behind the orbit; but the upper plate, as also sometimes the superior end of the lower plate, is separated from the preoperculum by a third element which is truncated above and acuminate below. There are also small cheek-plates surrounding the narial opening immediately in advance of the orbit; but the circumorbitals are insignificant and apparently do not form a continuous ring. The sclerotic is ossified. The dentary is much the largest element in the mandible and bears a single series of teeth on its oral border. It meets its fellow of the opposite side at the symphysis, and articulates in front with an azygous, bilaterally-symmetrical presymphysial bone. Posteriorly there is a small angular plate exposed on the outer face of the ramus; but the coronoid has not hitherto been observed. The splenial is a very thin lamina, excavated on its hinder border and bearing minute teeth.

On the branchial arches the calcified supports for the gill-filaments are always conspicuous. The opercular apparatus is complete, and there is a long series of branchiostegal rays; but a gular plate has not hitherto been observed.

The vertebral centra, so far as the present writer has observed them, are always in the form of delicate rings, each bearing its own arch. The ribs are very short and thin. In the abdominal region the neural spines appear to be separate from their supporting arches, though this is not quite certain; in the caudal region, both hæmal and neural spines are fused with their arches, and the latter with their respective centra. As might be expected from the stout proportions of the rays, the supports of the dorsal and anal fins are especially robust; and they are shown to be more numerous than the vertebral segments beneath them.

The scales are all thick and rhombic, strengthened by a slight internal median rib, and those of the flank united by a large peg-and-socket articulation. The lateral line pierces each scale it traverses.

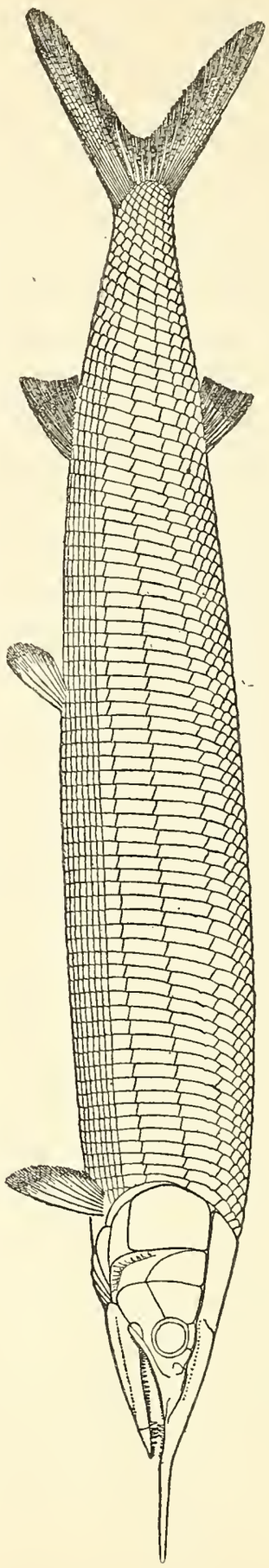


Fig. 42.

Aspidorhynchus acutirostris; restored outline.

A revised restoration of *Aspidorhynchus* is published by A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), 1918, p. 95, text-fig. 32.

1906. Aspid. acutir., E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 185, pl. xxviii. fig. 8, text-fig. 8.

1896. Aspid. acutir., H. Sculpin, Archiv f. Naturgesch. vol. i. p. 171, pl. x. fig. 7 [structure of scale].

1906. Aspid. acutir., P. Assmann, Archiv für Biontologie, vol i, p. 55, pls. vi, vii, text-figs. 1–6.

1914. Aspid. acutir., C. R. Eastman, Mem. Carnegie Mus., vol. vi, p. 420, pl. lxiv. fig. 3.

1949. A. a. P. de Saint-Seine N. Arch. mus. H.N. Lyon 2: p. 255, [illegible] pl. xxv f. 8, 9.

Aspidorhynchus acutirostris (Blainville).

1755. Figures by G. W. Knorr, Samml. Merkwürdigk. Natur, pt. i. p. 38, pls. xxiii., xxix. fig. 1.

1818. *Esox acutirostris*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 332.

1823. *Esox acutirostris*, J. F. Krüger, Geschichte der Urwelt, vol. ii. p. 665.

1833. *Aspidorhynchus acutirostris*, L. Agassiz, Neues Jahrb. p. 478, and Poiss. Foss. vol. ii. pt. i. p. 14.

1842. *Aspidorhynchus longissimus*, G. von Münster, Neues Jahrb. p. 44. [Nearly complete fish; Palæontological Museum, Munich.]

1844. *Aspidorhynchus acutirostris*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 136, pl. xlvi.

1844. *Aspidorhynchus speciosus*, L. Agassiz, *ibid.* p. 137, pl. xlv. [Imperfect trunk; Palæontological Museum, Munich.]

1842–44. *Aspidorhynchus ornatissimus*, L. Agassiz, *ibid.* p. 138, pl. xlvii. [Portion of fish; Palæontological Museum, Munich, and Woodwardian Museum, Cambridge.]

1844. *Aspidorhynchus mandibularis*, L. Agassiz, *ibid.* p. 138.

1861. *Belonostomus microcephalus*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 26, fig. 4.

1863. *Aspidorhynchus acutirostris*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 680.

1863. *Aspidorhynchus mandibularis*, A. Wagner, *ibid.* p. 684.

1871. *Aspidorhynchus ornatissimus*, T. C. Winkler, Archiv. Mus. Teyler, vol. iii. p. 183, pl. v. figs. 11, 12.

1881. *Aspidorhynchus acutirostris*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 83.

1887. *Aspidorhynchus acutirostris*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 220, figs. 233, 234.

1887. *Aspidorhynchus*, O. Reis, Sitzungsb. k. bay. Akad. Wiss., math.-phys. Cl. vol. xvii. p. 151, pl. i. figs. 1–3, 6, 7, pl. ii. figs. 1–4, 7.

Type. Nearly complete fish; Paris Museum of Natural History.

The type species, of large size, attaining a length of 1 metre. Head with opercular apparatus occupying somewhat less than one-quarter of the total length; maximum depth of trunk contained between nine and ten times in the total length. Cranium rapidly tapering to the acute rostrum, which projects in advance of the mandible to an extent at least equal to one-third of the total length of the cranium; cranial bones and operculum ornamented with granulations and short longitudinal rugæ, the latter especially conspicuous on the rostrum; preoperculum with radiating ridges at the angle; mandible and branchiostegal apparatus almost smooth; presymphysial bone rapidly tapering, twice as long as its maximum depth; upper laniary teeth at the base of the rostrum, one or two

teeth at the dentary symphysis, and a single tooth at the proximal end of the presymphysial bone large, the principal mandibular teeth of the dentary bone numerous, well-spaced, regularly arranged, and of moderate size. Pelvic fins arising midway between the pectorals and the caudal; anal with about 20 rays, slightly nearer to the pelvic fins than to the caudal, and dorsal fin, with about 12 rays, directly opposed to its anterior portion. Scales almost smooth in young individuals, coarsely though sparsely tuberculated and partly rugose in adults.

The synonymy and characters of this species given above are chiefly based on the researches of Wagner and Vetter. The last-named author also points out that the rostrum of the fish attains its full development at an early stage, subsequently only increasing in thickness; it thus appears relatively longer in the young than in the adult. One fine specimen from Eichstädt in the Palæontological Museum, Munich, only differs from the typical *A. acutirostris* in its somewhat blunter snout and is described under the specific name of *A. obtusirostris* by A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1863), p. 687.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 7574. Scattered remains of a large fish about one metre in length, in counterpart; Solenhofen. Some of the head-bones, ring-vertebræ, and highly ornamented scales are well shown; and the paired fins are preserved.

37777. Similar fish with squamation less displaced, in counterpart; Solenhofen. *Presented by W. G. Neville, Esq.*, 1863.

P. 3808. An equally large fish, wanting the snout but with well-preserved caudal fin and remains of the dorsal, anal, and paired fins; Solenhofen. As in the two previous specimens, the vertebral axis of the caudal region is curiously displaced and thrown upwards beyond the limits of the continuous squamation. *Enniskillen Coll.*

37791. Somewhat smaller specimen in a similar state of preservation, but having the vertebral axis disjointed and wanting the greater part of the head; Solenhofen.

Häberlein Coll.

P. 972, P. 3807. Imperfect contorted fish at least 0·85 in length, showing some of the finely ornamented squamation, in counterpart; Solenhofen. *Egerton & Enniskillen Colls.*

P. 972 a. Part of the pectoral fins and abdominal squamation of a similar specimen, labelled "*Aspidorhynchus acutirostris*, Agass.," by Agassiz; Solenhofen. *Egerton Coll.*

P. 972 b. Scattered remains of the head of another large fish, displaying among other elements the ceratohyal, epihyal, and expanded hyomandibular; Solenhofen. *Egerton Coll.*

36013–14. Similar remains of a large head with the pectoral fin, in counterpart; Solenhofen. The cranium is shown from above, and the branched character of the pectoral fin-rays is well displayed. *Purchased*, 1861.

P. 971. Head and anterior portion of the abdominal region exhibiting chiefly an ornament of rugæ, and labelled "*Aspidorhynchus speciosus*, Agass.," by Agassiz; Kelheim. *Egerton Coll.*

37790. Contorted fish 0·75 in length, with complete rostrum, several well-preserved vertebral rings and portions of squamation, and perfect caudal fin; Solenhofen. The rostrum is conspicuously marked with longitudinal rugæ. *Häberlein Coll.*

37802. Head of an equally large specimen, in counterpart, with the pectoral fin; Solenhofen. *Häberlein Coll.*

P. 2055. Fragmentary remains of large trunk with richly ornamented scales, labelled "*Aspidorhynchus acutirostris*, Agass.," by Agassiz; Solenhofen. *Egerton Coll.*

49145. Plaster cast of nearly complete fish 0·67 in length, the specimen figured by Agassiz, *tom. cit.* pl. xlvi. fig. 2; Solenhofen. *Purchased*, 1878.

P. 2056. Feeble impression of the head and imperfect trunk of a similar fish, showing vertebral rings; Kelheim. *Egerton Coll.*

P. 2057. Mandible, scattered head-bones, and part of the trunk of a similar fish; Solenhofen. *Egerton Coll.*

22657. Specimen 0·58 in length, with almost smooth scales and opercular apparatus; Solenhofen. The anal fin is especially well shown, with minute fulcra. *Purchased*, 1848.

37789. More imperfect specimen 0·55 in length, displaying the forked caudal fin; Solenhofen. In both this and the previous fish the dorsal fin is distinctly smaller than the

anal. The quadrate, symplectic, epihyal, and ceratohyal bones are conspicuous. The delicate ribs are shown.
Häberlein Coll.

P. 6940. Fine specimen, 0·56 in length; Eichstädt.
By exchange, 1893.

37068. Head of a similar fish in lateral aspect, displaying the dentition of the maxilla, dentary, and splenial bones; Solenhofen. A small plate above the hinder end of the maxilla seems to be the supramaxilla. *Häberlein Coll.*

P. 973. Another head with opercular apparatus, well preserved in lateral aspect, showing some of the ornament of the operculum and cranial roof. A small supramaxilla occurs above the hinder end of the maxilla; and the apertures of the lateral line are conspicuous along the outer face of the dentary. *Egerton Coll.*

P. 3805. Somewhat larger head, lateral aspect, with several bones crushed and displaced; Kelheim. The palato-pterygoid dentition is shown within the mouth, and part of the suture between the angular and dentary elements in the mandible can be distinguished. One of the branchial arches with its gill-supports is displaced below the mandible. The series of branchiostegal rays is also well-shown, about 12 in number on one side, and there are remains of the ossified sclerotic ring. *Enniskillen Coll.*

P. 970, P. 3806. Head and greater portion of trunk of a fish about 0·45 in length, very imperfectly preserved in counterpart; Solenhofen. The position of the notochord is indicated by a vacant space, the absence of calcified ring-vertebræ being doubtless due to the immaturity of the specimen. The scales are smooth. *Egerton & Enniskillen Colls.*

37803. Head and anterior abdominal flank-scales of a very small fish, with slender rostrum equalling nearly half of the total length of the cranium; Solenhofen.
Häberlein Coll.

P. 970 a. A slightly larger head with much elongated rostrum; Solenhofen. *Egerton Coll.*

Aspidorhynchus euodus, Egerton.

[Plate XVII. figs. 6–10.]

1845. *Aspidorhynchus euodus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. i. p. 231, with outline figs.

Type. Scales, rostrum, and presymphysial bone; unknown.

An imperfectly known species of moderate size. Cranium rapidly tapering to the acute rostrum, which projects in advance of the mandible to an extent scarcely exceeding one-quarter of the total length of the cranium; cranial bones ornamented with granulations and short longitudinal rugæ, mandible and opercular bones almost smooth; presymphysial bone slender and tapering, length about three times as great as its maximum depth; upper laniary teeth at the base of the rostrum, one tooth at the dentary symphysis, and a single tooth at the proximal end of the presymphysial bone very large, the principal mandibular teeth of the dentary bone well spaced and of moderate size. Scales feebly rugose.

Form. & Loc. Oxfordian; Wiltshire.

All the following specimens were obtained from Christian Malford, near Chippenham:—

40518. Imperfect head and opercular bones, with scattered scales and ring-vertebræ. The tip of the rostrum is broken away, and the whole of the mandible, except the presymphysial bone, is wanting. The pterygo-quadrate arcade, however, and the dentigerous base of the rostrum are well-preserved. The skull is shown of the natural size in Pl. XVII. fig. 6. The characteristic narrow parasphenoid (*pas.*) is exposed in the middle of the cranium and the nasal opening (*na.*) is indicated immediately in advance of the orbit. The quadrate bone (*qu.*) is fan-shaped, with a relatively small condyle. The ectopterygoid (*ecpt.*) is toothless behind, where deeply expanded, and its slender, closely-set teeth gradually increase in size from behind forwards: it meets the palatine (*pl.*) at an uncertain point in front, this bone bearing a single large tooth posteriorly and a regular, close series of small teeth anteriorly. The entopterygoid (*enpt.*) is long and narrow, but imperfectly exhibited, and the metapterygoid is of uncertain form. Overlying the operculum of the left side, which is exposed from its inner face, is a long, narrow, laminar bone (*pt.*), tapering above, abruptly

truncated below, strengthened with a ridge on its anterior margin, and evidently to be interpreted as the left post-temporal element. The presymphysial bone exhibits its characteristic tapering form, with the large unsymmetrically-placed tooth at its base. Most of the scales are exposed from the inner aspect, showing the large peg-and-socket articulation and broad, flattened, inner ridge; but the external face is evidently rugose. *Purchased*, 1867.

P. 7575. Crushed remains of small head and abdominal region. The large teeth on the presymphysial bone are well displayed. *History unknown.*

P. 967 a, b. Two fragmentary specimens of the head and abdominal region, the first showing the base of the pectoral fin and the rugose ornament of the scales, besides some tuberculated head-bones. *Egerton Coll.*

46345—a. Small head, in counterpart, lateral aspect, showing the jaws but wanting the dentary bone; also a detached rostrum. *Cunnington Coll.*

P. 5147, P. 967 c. Imperfect remains of a small head, and a detached rostrum. *Egerton Coll.*

P. 4281–2. Portions of head in side view, showing the associated rostrum, presymphysial bone, operculum, and subopercular, and detached splenial bones. *Enniskillen Coll.*

29042–44. Fine large cranium broken across the middle, the cranial roof exposed from above and the rostrum from below (Pl. XVII. fig. 7); an equally large cranium, imperfect behind, displayed from the infero-lateral aspect; and a detached rostrum with premaxillary dentition. In the first specimen, as shown in the figure, the cranial roof is ornamented with tubercles and longitudinal rugæ, and is produced backwards at its postero-lateral angles; the frontals (*fr.*) are evidently large compared with the parietals (*pa.*), though the intervening suture is not very clear; and the parasphenoid (*pas.*) is crushed outwards on the right side. At the base of the rostrum a V-shaped eminence (*v.*) on its inferior face seems to represent a pair of toothless vomers united in front; and the groove between the long dentigerous premaxillæ (*pmx.*) is continued forwards along the lower face of the rostral prolongation. The prefrontals (*pf.*) seem to have been well ossified. *Purchased*, 1854.

P. 967 α = *Heterosthophus*

1918. *Sphenacanthus fisheri*, A. S. Woodward, Jour. Fish. Weald. & Purb. Form. (Pal. Soc. 1916), p. 97, pl. xx. figs. 1–4.

37319. Rostrum in side view, well displaying the premaxillary dentition. *Purchased*, 1863.

21430-a. Two small rostra. *Purchased*, 1847.

46350. Two ectopterygoid bones. *Cunnington Coll.*

21430 b. Another ectopterygoid. *Purchased*, 1847.

29045. Large maxilla and two fragments. *Purchased*, 1854.

29045 a. Maxilla, shown of the natural size in Pl. XVII. fig. 8. *Purchased*, 1854.

46349. Small maxilla. *Cunnington Coll.*

40519, 41296, 42295, 46412. Six detached dentary bones, the largest shown of the natural size in Pl. XVII. fig. 9. *Purchased*, 1867, 1869, 1870, 1875.

P. 967 d. Right dentary bone. *Egerton Coll.*

21430 c, 24676, 29047. Four splenial bones, one shown of the natural size in Pl. XVII. fig. 10. *Purchased*, 1847, 1850, 1854.

Aspidorhynchus sphekodes, Sauvage.

1893. *Aspidorhynchus sphekodes*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. p. 431, pl. viii. fig. 1.

Type. Fish wanting paired fins.

A much-elongated species attaining a length of about 0·3. Head with opercular apparatus occupying about one-quarter of the total length; maximum depth of trunk contained considerably more than ten times in the total length. Rostrum slender, projecting in advance of the mandible for a length equalling about one-third that of the cranium; cranial roof-bones rugose and in part tuberculated. Scales smooth.

Form. & Loc. Lower Kimmeridgian: Orbagnoux, Ain, France.

Not represented in the Collection.

Aspidorhynchus fisheri, Egerton.

1854–55. *Aspidorhynchus fisheri*, Sir P. Egerton, Ann. Mag. Nat. Hist. [2] vol. xiii. p. 434, and Figs. & Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv.), no. 6, pl. vi.

1880. *Aspidorhynchus fisheri*, A. Günther, Study of Fishes, p. 369, fig. 146.

Type. Nearly complete fish; Dorchester Museum.

A species attaining a length of about 0·35–0·4. Head with

opercular apparatus comprised nearly four-and-a-half times in the total length; maximum depth of trunk equalling about one-ninth of the total length of the fish. Cranium rapidly tapering to the acute rostrum, which is produced in advance of the mandible to equal one-third of the total length of the cranium; cranial bones and cheek-plates ornamented with fine granulations, which are fused into longitudinal rugæ on the rostrum and sometimes on part of the cranial roof; mandible and opercular bones almost smooth; presymphysial bone very short, scarcely longer than deep; mandibular teeth very robust. Pelvic fins situated far behind the middle point of the trunk. Scales smooth, except those of the dorsal region, which are marked with longitudinal rugæ.

The "single row of small close-set tubercles," noted by Egerton on the ramus of the mandible, is an appearance due to the orifices of the sensory canal.

Form. & Loc. Purbeckian: Dorsetshire.

28621. Head and abdominal region, lateral and partly superior aspect, with the base of the right pectoral fin; Swanage. In the mandible the presymphysial bone is well shown, and the head is figured in Günther's 'Introduction to the Study of Fishes,' p. 369, fig. 146 (copied in Proc. Geol. Soc. 1884, p. 50, fig. 4). *Purchased*, 1853.

P. 6380. Imperfect cranium and the greater portion of the trunk, much fractured; Swanage. The ornamentation of the dorsal scales is well shown, and there are slight traces of serrations on some of the deep flank-scales. *Beckles Coll.*

Aspidorhynchus crassus, A. S. Woodward.

[Plate XVII. fig. 11.]

1844. *Sauropsis mordax,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 122 (name only).

1871. *Pholidophorus minor*?, J. Phillips, Geol. Oxford, p. 180, woodc. xl, figs. 5, 6. [Mandibular ramus; Oxford Museum.]

(?) 1871. *Belonostomus flexuous,* J. Phillips, *ibid.* fig. 3. [Maxilla?; Oxford Museum.]

1888. *Aspidorhynchus* sp., A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. i. p. 355.

1890. *Aspidorhynchus crassus,* A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 295, pl. iii. figs. 11–14.

Type. Cranium; British Museum.

A small species known only by cranium and jaws. Cranium low, gradually tapering to the acute rostrum, which is produced in advance of the mandible to equal one-third of the total length of

28621. Des? & fig? A.S.W. 1918, p. 97, pl. xx. fig. 2.

P.6380. Dorsal scales, des? & fig? A.S.W. 1918, p. 99, pl. xx. fig. 4.

the cranium; cranial bones ornamented with prominent rugæ and granulations, mandible almost smooth; principal mandibular teeth broad, of moderate size, and well spaced; presymphysial bone about three times as long as its maximum depth.

Form. & Loc. Bathonian; Oxfordshire.

39199, 39200. The type specimens, two skulls described and figured in Proc. Geol. Assoc. vol. xi. p. 295, pl. iii. figs. 11, 12; Stonesfield Slate, Stonesfield, near Oxford. *Bowerbank Coll.*

P. 959. Two portions of cranial roof; Stonesfield. *Egerton Coll.*

P. 3720 a. Right maxilla, figured *loc. cit.* pl. iii. fig. 13; Stonesfield. *Enniskillen Coll.*

P. 877 b. Fragment probably of a maxilla of this species; Stonesfield. *Egerton Coll.*

P. 3720 b. Left dentary bone, figured *loc. cit.* pl. iii. fig. 14; Stonesfield. *Enniskillen Coll.*

41294. Left dentary; Stonesfield. *Purchased*, 1869.

P. 877 a, c, d. Three imperfect dentaries; Stonesfield. *Egerton Coll.*

P. 3720 c, d, e. Three imperfect dentaries; Stonesfield. *Enniskillen Coll.*

P. 3720 g. Presymphysial bone with teeth, shown of the natural size in Pl. XVII. fig. 11. *Enniskillen Coll.*

P. 3720 f. Imperfect left pterygoid arcade; Stonesfield. *Enniskillen Coll.*

The following specimen is too imperfect for specific determination:—

P. 2058. Much-disturbed remains of a fish measuring about 0·36 from the pectoral arch to the base of the caudal fin; Lithographic Stone, Cirin, Ain, France. The trunk appears to be stouter than in *A. acutirostris* from Bavaria, and all the scales exhibited are smooth. Ring-vertebræ are displayed, and the ribs shown in the abdominal region are both short and delicate. Of the anal fin 16 supports are preserved, while there is only evidence of 12 rays in the dorsal. *Egerton Coll.*

Aspidorhynchus silesianus is an undefined name given by Hohenegger to some fragments from the Aptian of Wernsdorf, Moravia,

in the Palæontological Museum, Munich (F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. 1882, p. 264; K. A. von Zittel, Handb. Palæont. vol. iii. 1887, p. 221).

Aspidorhynchus walchneri is another undefined name applied to fragments of the skull of *Belonorhynchus* from the Upper Lias of Baden and Würtemberg (L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1833, p. 14; F. A. Quenstedt, Flözgeb. Württemb. 1843, p. 244 (ed. 2, 1851, p. 563), and Der Jura, 1858, p. 234).

An indeterminable portion of skull and anterior vertebræ from the Cretaceous of Pietrarojà, Benevento, now in the Geological Museum of the University of Naples, bears the name of *Aspidorhynchus platycephalus* (O. G. Costa, Atti Accad. Pontan. vol. viii. 1864, pp. 62, 193, pl. ix. fig. 8; discussed by F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. 1882, p. 231). The same specimen was previously described under the name of *Dichelospondylus longirostris* by O. G. Costa, Ittiol. Foss. Ital. (1856), p. 18, pl. ii. fig. 8.

Genus **BELONOSTOMUS,** Agassiz.

[Neues Jahrb. 1834, p. 388.]

Syn. *Ophirachis,* O. G. Costa, Ittiol. Foss. Ital. 1856, p. 13.

Snout very slender, scarcely, if at all, produced in front of the extremity of the much-elongated presymphysial bone; cheek-plates robust, the postorbitals extending to the anterior border of the preoperculum; the conical teeth irregular in size, largest on the hinder part of the premaxillæ and the median line of the presymphysial bone, obtuse on the splenial, and reduced to a fine granulation on the inner face of the ectopterygoid. Ossified vertebræ usually pierced by a remnant of the notochord. Fin-rays distally bifurcating; fulcra wanting on paired fins, rare on median fins. Pelvic fins situated near the middle of the trunk; dorsal and anal fins short-based, triangular, remote and opposed; caudal fin symmetrically forked. Scales robust, smooth or rugose; in three deepened series on the flank of the abdominal region, and the series traversed by the lateral line the deepest; dorsal scales between the flank-scales and the median ridge in two series.

Belonostomus sphyrænoides, Agassiz.

1837. *Belanostomus sphyrænoides,* L. Agassiz, Bericht. Versamml. deutsch. Naturf., Jena, 1836, p. 127 (name only).

1837. *Belanostomus brachysomus,* L. Agassiz, *ibid.* p. 127 (name only).

P. Mis sancti s.a. Kramb. Goj. 1895 Kjelk
Svgost. Akad. 16 p. 8 pl. 1. f. 2, 2a. Cretac. Mozlec.

Aspidorhynchus sp.? Etheridge, 1872. Q.J.G.S., 28, 346. Cretac., Queensland.

Diphyodus, L. M. Lambe, Contrib. Canadian Paleont. vol iii. pt. ii. 1902, p. 30.

(?) 1842. *Belonostomus angustus*, G. von Münster, Neues Jahrb. p. 45 (imperfectly defined). [Fish, wanting jaws; Palæontological Museum, Munich.]

1844. *Belonostomus sphyrænoides*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 140, 297, pl. xlvii. *a*. fig. 5.

1844. *Belonostomus brachysomus*, L. Agassiz, *ibid.* pt. ii. pp. 143, 297.

1863. *Belonostomus sphyrænoides*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 690.

Type. Nearly complete fish; Palæontological Museum, Munich, and Woodwardian Museum, Cambridge.

The type species, attaining a length of about 0·3. Head with opercular apparatus occupying about one-third of the total length; maximum depth of trunk contained twelve times in the total length. Cranium about five times as long as its maximum depth; jaws equal in length. Vertebræ in the form of robust constricted rings, scarcely longer than deep. Space between the origin of the pelvic fins and that of the anal fin less than the space between the latter and the caudal. Scales smooth or very feebly tuberculated; those of the lateral line not much exceeding in depth the series below.

Form. & Loc. Lower Kimmeridgian: Bavaria.

49129. Plaster cast of type specimen; Lithographic Stone, Eichstädt. *Purchased*, 1878.

37800. Large imperfectly preserved fish about 0·285 in length, contorted, of the variety named *B. brachysomus* by Agassiz; Solenhofen. *Häberlein Coll.*

P. 3800. Trunk nearly complete from the pelvic fin backwards, but disturbed in front, probably of this species; Kelheim. *Enniskillen Coll.*

P. 7576. Extremity of tail with caudal fin, probably of this species; Kelheim. *Egerton Coll.*

Belonostomus muensteri, Agassiz.

1834. *Aspidorhynchus münsteri*, L. Agassiz, Verhandl. Ges. vaterländ. Mus. Böhmen, p. 70 (name only).

1837. *Belanostomus münsteri*, L. Agassiz, Bericht. Versamml. deutsch. Naturf., Jena, 1836, p. 127 (name only).

1844. *Belonostomus münsteri*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 141, 297, pl. xlvii. *a*. fig. 2.

1848. *Belonostomus muensteri*, C. G. Giebel, Fauna der Vorwelt, Fische, p. 155.

1861. *Belonostomus münsteri*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 34, fig. 5.

1863. *Belonostomus münsteri*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 689.

1863. *Belonostomus speciosus*, A. Wagner, *ibid.* p. 689. [Imperfect fish; Palæontological Museum, Munich.]

1887. *Belonostomus speciosus*, O. Reis, Sitzungsb. k. bay. Akad. Wiss., math.-phys. Cl. vol. xvii. p. 159, pl. i. fig. 4.

Type. Head and anterior part of trunk; British Museum.

A species of moderate size attaining a length of about 0·4. Head with opercular apparatus occupying about one-quarter of the total length; maximum depth of trunk contained fifteen times in the total length. Cranium about five times as long as its maximum depth; jaws equal in length, the pointed anterior extremity of the dentary bones suturally united with a deep re-entering angle in the presymphysial bone; external ornament very finely rugose. Vertebræ in the form of robust constricted rings, longer than deep. Space between the origin of the pelvic fins and that of the anal fin about equal to the space between the latter and the caudal. Scales finely tuberculated, partly rugose; those of the lateral line not much exceeding in depth the series below.

Form. & Loc. Lower Kimmeridgian: Bavaria, and (?) Ain, France.

P. 505, P. 3801. The type specimen described and figured by Agassiz, in counterpart; Lithographic Stone, Solenhofen. The suture at the proximal end of the presymphysial bone is well shown. *Egerton & Enniskillen Colls.*

37798. Large specimen in counterpart, wanting the dorsal, anal, and pelvic fins, and part of the caudal fin, with much-disturbed squamation; Solenhofen. *Häberlein Coll.*

37796, 37799, 37801. Three large specimens, variously imperfect, showing several of the principal characters of the species; Solenhofen. *Häberlein Coll.*

P. 3802. A similar specimen, contorted, wanting all the fins except the basal half of the caudal; Solenhofen. *Enniskillen Coll.*

37797. Imperfect vertebral column, with remains of the head and scattered scales; Solenhofen. The suture between the presymphysial and dentary bones is shown; and in the caudal region the short neural and hæmal arches and spines are preserved. *Häberlein Coll.*

P. 4690. Head wanting rostrum, with trunk wanting caudal region, of the form ascribed to this species by Thiollière, Poiss. Foss. Bugey, pt. ii. (1873), p. 24; Cirin, Ain, France. *Purchased*, 1884.

1914. *Bel. muensteri*, C. R. Eastman, Mem. Carnegie Mus., vol vi, p. 420, pl. Ix. fig. 1; (?) also p. 376, pl IV. f. 2, 3.

1911. Belonostomus tenuirostris, C. R. Eastman, Ann. Carnegie Mus. vol. viii. p. 184, pl. x.

1914. Belonostomus tenuirostris, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 377, pl. 71. fig. 3.

1917. Belonostomus tenuirostris, C. R. Eastman, Proc. U.S. Nat. Mus. vol. 71i. p. 286, pl xiv. fig. 2.

1949. B. E. P. de Saint-Seine, N. Arch. Mus. H.N. Lyon p. 257, fig. 114 pl xxiv f. C, D; xxv f. B, C.

Belonostomus kochi, Agassiz.

1834. *Aspidorhynchus lepturus,* L. Agassiz, Verhandl. Ges. vaterländ. Mus. Böhmen, p. 70 (name only).
1844. *Aspidorhynchus lepturus,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 139 (undefined).
1844. *Belonostomus kochii,* L. Agassiz, *ibid.* p. 143.
1863. *Belonostomus kochii,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 689.

Type. Nearly complete fish; Palæontological Museum, Munich.

A species closely related to *B. muensteri*, but less elongated and of more delicate proportions; head with opercular apparatus occupying one-quarter of the total length. Jaws equal in length.

An immature example apparently of this species in the Palæontological Museum, Munich, is labelled *B. longimanus* by Münster.

Form. & Loc. Lower Kimmeridgian: Bavaria.

49136. Plaster cast of type specimen 0·275 in length; Lithographic Stone, Kelheim. *Purchased,* 1878.

Belonostomus tenuirostris, Agassiz.

[Plate XVII. fig. 12.]

1833. *Aspidorhynchus tenuirostris,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 14.
1834. *Belonostomus tenuirostris,* L. Agassiz, Neues Jahrb. p. 388.
1837. *Belanostomus tenuirostris,* L. Agassiz, Bericht. Versamml. deutsch. Naturf., Jena, 1836, p. 127.
1837. *Belanostomus tabulatus,* L. Agassiz, *ibid.* p. 127 (name only).
1844. *Belonostomus tenuirostris,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 143, 297.
1844. *Belonostomus subulatus,* L. Agassiz, *ibid.* pp. 143, 297. [Imperfect anterior half of fish; Palæontological Museum, Munich.]
1863. *Belonostomus tenuirostris,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 691.
1863. *Belonostomus tenuirostris,* var. *brevivertebralis,* A. Wagner, *ibid.* p. 691.
1881. *Belonostomus tenuirostris,* B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 85.

Type. Head, &c.; unknown.

A species of very slender proportions attaining a length of about 0·3. Head with opercular apparatus occupying one-third of the total length; maximum depth of trunk contained fourteen times in the total length. Cranium about nine times as long as its maximum depth, having the snout excessively elongated, and projecting to

some extent in advance of the anterior extremity of the mandible; the pointed front end of the dentary bones suturally united with a deep re-entering angle in the presymphysial bone; superficial ornament consisting of delicate rugæ. Vertebræ in the form of separated narrow rings, much deeper than broad. Scales smooth or feebly tuberculated and rugose; those of the lateral line not much exceeding in depth the series below.

The vertebral rings in this species evidently differ from those of the preceding species merely in the circumstance that they represent a lower stage of calcification than the elongated constricted rings already described. This is indicated by the considerable width of the spaces between the successive rings.

Form. & Loc. Lower Kimmeridgian: Bavaria, and (?) Ain, France.

35014. Head and greater part of the trunk with paired fins, the head shown of the natural size in Pl. XVII. fig. 12; Lithographic Stone, Solenhofen. The specimen is exhibited in side view, displaying the shortness of the mandible, the suture separating the presymphysial bone (*ps.*) from the dentary (*d.*), and the proportions of the opercular apparatus. The fins are fragmentary, and the scales are mostly shown in obscure impressions.

Purchased, 1860.

36029. Contorted fish showing the principal specific characters, including the incomplete calcification of the notochordal sheath in the form of deep and narrow separated rings; Solenhofen. *Purchased*, 1861.

P. 962. Imperfect specimen showing the head and greater part of the trunk with pectoral fins chiefly in impression; Solenhofen. *Egerton Coll.*

P. 962 a. Detached skull and mandible, much crushed, showing the superficial rugose ornament, some of the teeth in the lower jaw, and the suture between the dentary and presymphysial bone; Solenhofen. *Egerton Coll.*

P. 2001. Two imperfect specimens chiefly in impression, probably of this species; Cirin, Ain, France. The dorsal ridge-scales in one specimen are coarsely rugose. *Egerton Coll.*

The following imperfect specimen appears to exhibit a snout as much attenuated as that of *Belonostomus tenuirostris*, but the fish is of larger dimensions than usual in this species and the squamation has more nearly the aspect of that of *B. muensteri*. The specimen

is labelled *Belonostomus ventralis*, apparently in Agassiz' handwriting; but this species has not been adequately defined (L. Agassiz, Bericht. Versamml. deutsch. Naturf., Jena, 1836, p. 127, and Poiss. Foss. vol. ii. pt. ii. 1844, pp. 143, 297), and the type specimen is said by A. Wagner to be specifically indeterminable (Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 692):—

P. 7577. Remains of head and greater portion of trunk of a fish in counterpart, noticed and figured as *Serpens marinus* in J. J. Baier's 'Monumenta rerum petrificatarum' (Nuremburg, 1757), p. 10, pl. vi. fig. 4; Lithographic Stone, Solenhofen, Bavaria. Though not satisfactorily shown, it seems probable that the much-attenuated rostrum projected in advance of the mandible, in which the presymphysial bone is distinctly separated from the dentary by suture. The scales are comparatively robust, and some exhibit a tuberculated or rugose ornament.

History unknown.

Belonostomus dorsetensis, sp. nov.

[Plate XIV. fig. 2.]

Type. Imperfect skull and mandible; British Museum.

A species of moderate size known only by the head, which attains a length of about 0·115. Rostrum much attenuated and projecting for some distance in advance of the anterior extremity of the mandible; the blunt anterior extremity of the dentary bones suturally united with a slight excavation in the presymphysial bone, and the median series of widely-spaced teeth on this bone relatively large; ornament of cranium consisting of fine rugæ of ganoine, that of the mandible only of structural rugæ.

Form. & Loc. Kimmeridge Clay: Dorsetshire.

P. 6175. The type specimen shown of the natural size in Pl. XIV. fig. 2, comprising the vertically crushed cranium imperfect behind, the left ectopterygoid (*ecpt.*) and imperfect dentary (*d.*), and the presymphysial bone (*ps.*); Kimmeridge Clay, Weymouth. The rostrum is shown to extend considerably in advance of the dentigerous premaxillæ and exhibits a longitudinal groove on its inferior aspect; the presymphysial bone is dentigerous throughout its length. The ectopterygoid is granulated on its inner face and bears a single row of closely arranged, elongated conical

teeth on its outer margin; the dentary has an irregular series of large conical teeth in its hinder two-thirds, very small closely-set teeth in front. *Purchased*, 1890.

P. 6175 a. Laterally compressed rostrum and presymphysial bone, probably associated; Weymouth. *Purchased*, 1890.

41180, 41229, 41401, 42368, 43566, 44190. Twelve fragments of cranium, variously crushed; Weymouth.
Purchased, 1868–73.

43564. Complete presymphysial bone 0·04 in length, and four times as long as its maximum depth; Weymouth.
Purchased, 1872.

41229 a, 41401 a, 41879, 42365, 43027, 43565, 44189, P. 6175 b. About twenty specimens of the presymphysial bone, more or less imperfect and of various sizes; Weymouth.
Purchased, 1868, 1869, to 1890.

Belonostomus crassirostris, Costa.

1853. *Belonostomus crassirostris*, O. G. Costa, Atti Accad. Pontan. vol. vii. p. 29, pl. ii. figs. 1, 2.

1853. *Belonostomus gracilis*, O. G. Costa, *ibid.* p. 31, pl. ii. fig. 3. [Portion of rostrum; Geological Museum, University of Naples.]

Type. Fish wanting pelvic fins; Geological Museum, University of Naples.

A species attaining a length of 0·6, with relatively small head occupying about one-sixth of the total length. Scales smooth, and those of the lateral line much exceeding in depth the series below.

Form. & Loc. Cretaceous: Pietraroja, Province of Benevento, Italy.

Not represented in the Collection.

Belonostomus lesinaensis, Bassani.

(?) 1867. *Hemirhynchus heckeli*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. lvi. pt. i. p. 182. [Head; Museum of Imperial Geological Survey, Vienna.]

(?) 1867. *Hemirhynchus comenianus*, R. Kner, *ibid.* p. 182. [Head; Museum of Imperial Geological Survey, Vienna.]

1879. *Belonostomus crassirostris*, F. Bassani (*errore*), Verhandl. k.-k. geol. Reichsanst. p. 166.

1882. *Belonostomus lesinaensis*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 198, pl. i. fig. 10.

Type. Nearly complete fish; Museum of Imperial Geological Survey, Vienna.

1856. Sarcionota proboscidata, O. G. Costa, ibid. p. 363, pl. xxviii. fig. 12.

1915. Belonostomus crassirostris, G. D'Erasmo, Paleont. Italica, vol. xxi. p. 1, pl. i. figs. 1, 2.

1955. B. of. c. C. Arambourg, Not. Mém. Serv. Géol. Maroc. 118 p. 22. pl. i. Cenoman. Morocco.

1946. B. c. G. D'Erasmo. p. 24 fig. 8, 9.

1896. Belonostomus comptoni, H. Sauvin, Archiv f. Naturgesch. vol. i. p. 172, pl. x. fig. 8 [structure of scale].

1908. Belonostomus comptoni, D. S. Jordan & J. C. Branner, Smithson. Miscell. Coll. vol. 7ii. p. 10, pl. i. text-figs. 3-5.

1920. Vinctifer comptoni, D. S. Jordan, Proc. Acad. Nat. Sci. Philad. 1919, p. 210. [T. of Vinctifer.] "deeper lateral scales and stouter jaws than in Belonostomus."

1923 (1921) Vinctifer comptoni, D. S. Jordan, Peixes cretaceos do Ceará e Piauhy, (Monogr. Serv. Geol. e Min. Brasil, vol. iii.) p. 10, pl. 1. [with restoration].

1938. Belonostomus comptoni, S. D'Erasmo, p. 5, pl. i. 1-3; pl. ii, 1-2.

1945. Aspidorhynchus comptoni R. S. Santos, Not. prel. bol. geol. min. R. de J. no. 29 12 pp. 1 pl. [rest?].

A slender species attaining a length of at least 0·3. Head with opercular apparatus contained about three-and-a-half times, and maximum depth of trunk fifteen times in the total length; jaws nearly equal in length. Anterior scales of lateral line about twice as deep as broad.

Form. & Loc. Cretaceous: Island of Lesina, Dalmatia; (?) also Comen, Istria.

Not represented in the Collection.

Belonostomus comptoni (Agassiz).

1841. *Aspidorhynchus comptoni*, L. Agassiz, Edinb. New Phil. Journ. vol. xxx. p. 83.

1844. *Aspidorhynchus comptoni*, L. Agassiz, Comptes Rendus, vol. xviii. p. 1009.

1890. *Belonostomus comptoni*, A. S. Woodward, Proc. Zool. Soc. p. 629, pls. liv., lv. figs. 1–10.

Type. Distorted fish, imperfect anteriorly and posteriorly; British Museum.

A large species attaining a length of about 0·8. Head with opercular apparatus occupying somewhat less than one-third of the total length; maximum depth of trunk contained about ten times in the total length. Snout rapidly tapering to a very slender rostrum; external ornament of head and opercular apparatus consisting of thick, closely-arranged, rounded rugæ of ganoine; [jaws unknown]. Vertebræ well-ossified, smooth and constricted, about as long as deep, and pierced by a small thread of persistent notochord. Scales ornamented with a conspicuous, fine rugosity, and a vertical ridge on each of the scales in the two deepened series of the flank; the scales of the lateral line truncated inferiorly and much exceeding in depth the series below, those on the anterior portion of the abdominal region being at least five times as deep as broad.

Form. & Loc. Upper Cretaceous: Province of Ceara, Brazil.

47892. Hinder portion of head and greater portion of trunk described and figured in Proc. Zool. Soc. 1890, p. 629, pl. liv.; Barra do Jardim, Serra de Araripe, North Brazil. This may be regarded as the type specimen, the few fragments noticed by Agassiz being too imperfectly described and now lost.

Presented by the Hon. Robert Marsham, 1877.

15495 e, a. Two specimens showing the upper aspect of the cranium and remains of the anterior portion of the trunk;

Barra do Jardim. An upper view of the rostrum of the first specimen is given *loc. cit.* pl. lv. fig. 1, and a transverse section of the rostrum in the second specimen is shown, with the upper part of the operculum, *ibid.* pl. lv. figs. 2, 4. *Purchased*, 1843.

45931. Small fish in counterpart, wanting the greater part of the head and all the fins except the dorsal; Barra do Jardim. *Presented by Sir John Lubbock, Bart.*, 1874.

P. 975 e, P. 3810. Greater portion of head and abdominal region of a large fish in counterpart; Barra do Jardim. The head is broken so as to expose the pterygo-palatine arch, and is noticed *loc. cit.* p. 631. *Egerton & Enniskillen Colls.*

28899, P. 975 f. Scattered bones of head, including the cranial roof, with remains of the contorted trunk, half in counterpart; Barra do Jardim. *Dixon & Egerton Colls.*

P. 975 b. Small fish wanting rostrum and caudal region, showing the continuation of the cranial roof by bones above the operculum, and noticed *loc. cit.* pp. 630, 631; Barra do Jardim. *Egerton Coll.*

28616. A still smaller fish, contorted, wanting the rostrum and part of caudal region; Barra do Jardim. This specimen shows minute conical teeth in the upper jaw, as noted *loc. cit.* p. 631. *Purchased*, 1853.

47895. Hinder portion of head and part of the abdominal region of a small fish; Barra do Jardim. *Presented by the Hon. Robert Marsham*, 1877.

15495 b. Right hyomandibular, operculum, suboperculum, supraclavicle, clavicle, and anterior flank-scales of a large fish; Barra do Jardim. The hyomandibular is shown *loc. cit.* pl. lv. fig. 3. *Purchased*, 1843.

P. 975 g. Remains of head and anterior abdominal region, labelled "*Aspidorhynchus comptoni*, Agassiz," in Agassiz' handwriting; Barra do Jardim. *Egerton Coll.*

P. 975 c. Fragmentary trunk exhibiting some of the vertebræ, two of the caudals being described and figured *loc. cit.* p. 631, pl. lv. fig. 5; Barra do Jardim. *Egerton Coll.*

Belonostomus (?) carinatus, A. S. Woodw.

1907. Belonostomus (?) carinatus, A. S. Woodward, Quart. Jour. Geol. Soc. vol. lxiii. p. 133, pl. vi. figs. 4, 5.

Type. Scales; British Museum.

Form & Loc. Lower Cretaceous: Bahia, Brazil.

P. 10062. Group of scales, the type specimen &c.

& fig.s loc. cit.; Itacarámba, near Bahia.

Pres.d by Joseph Mawson, Esq., 1904.

P. 975 h. Anterior part of the abdominal region, displaying dorsal scales, with remains of the head and opercular apparatus in counterpart; Barra do Jardim. *Egerton Coll.*

P. 3809. Portion of the dorsal squamation, shown of the natural size *loc. cit.* pl. lv. figs. 7, 8; Barra do Jardim.
Enniskillen Coll.

47894. Caudal region, in counterpart, figured *loc. cit.* pl. lv. fig. 9; Barra do Jardim.
Presented by the Hon. Robert Marsham, 1877.

47896. Imperfect caudal fin, figured *loc. cit.* pl. lv. fig. 10; Barra do Jardim. *Presented by the Hon. Robert Marsham*, 1877.

P. 975 d. Extremity of tail showing expanded hæmal arches of vertebral column, noticed *loc. cit.* p. 631; Barra do Jardim. *Egerton Coll.*

P. 3810 a, P. 3811 a. Caudal region in counterpart, and a more imperfect specimen of the same; Barra do Jardim.
Enniskillen Coll.

47893. Portion of comparatively smooth squamation of a small fish, in counterpart; Barra do Jardim.
Presented by the Hon. Robert Marsham, 1877.

15494, 15496, 28616 a, 28899 a. Four fragments; Barra do Jardim.
Purchased, 1843, 1853, *& Dixon Coll.*

P. 975. Five fragments, one having a counterpart in the Enniskillen Collection (no. P. 3811). *Egerton Coll.*

Belonostomus sweeti, Etheridge & Woodward.

1892. *Belonostomus sweeti*, R. Etheridge, jun., and A. S. Woodward, Trans. Roy. Soc. Victoria, vol. ii. pt ii. p. 3, pl. i.

Type. Imperfect fish; collection of George Sweet, Esq., Melbourne.

A large species attaining a length of about 1 metre, closely similar in form and proportions to *B. comptoni*, but the rugæ on the principal flank-scales always passing into fine, parallel, horizontal striations towards the hinder margin.

Form. & Loc. Cretaceous (Rolling Downs Formation): Queensland.

P. 7539. Fragments of trunk.
Presented by George Sweet, Esq., 1895.

Belonostomus cinctus, Agassiz.

1837–44. *Belonostomus cinctus,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 142, pl. lxvi. *a.* figs. 10–13.

1850. *Belonostomus cinctus,* F. Dixon, Geol. Sussex, p. 367, pl. xxxv. figs. 3, 3*.

1888. *Belonostomus cinctus,* A. S. Woodward, Quart. Journ. Geol. Soc. vol. xliv. p. 145, pl. vii. figs. 7–13.

Type. Portion of squamation; British Museum.

An imperfectly known species of large size, the cranium attaining a length of at least 0·24. Jaws very slender, the presymphysial bone 15 times as long as its maximum depth, keeled below, marked with feeble longitudinal striæ, and overlapping the mandibular symphysis in an oblique suture; teeth obtuse, mammillated, on the splenial bone, and the median series on the presymphysial bone large, sharply conical, and well-spaced. Scales of flank smooth, those of the dorsal region marked with delicate longitudinal rugæ; the scales of the lateral line truncated inferiorly and much exceeding in depth the series below, those on the anterior portion of the abdominal region being about four times as deep as broad.

A mandible of this species in the Brighton Museum shows the dentary completely excluded by the splenial from the oral border.

Form. & Loc. Upper Cretaceous: S.E. England.

4266. Type specimen showing inner aspect of part of the squamation of the flank, described and figured by Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 142, pl. lxvi. *a.* fig. 13; Upper Chalk, Lewes, Sussex. *Mantell Coll.*

P. 7578. Fragment of squamation showing smooth flank-scales and ornamented dorsal scales; English Chalk.
History unknown.

4267, 4268. Two imperfect presymphysial bones, noticed and figured by Agassiz, *loc. cit.* p. 142, pl. lxvi. *a.* figs. 10–12; Lewes. *Mantell Coll.*

39057. Presymphysial bone, split longitudinally; Chalk, Burham, Kent. *Bowerbank Coll.*

P. 3804. Portion of presymphysial bone; Burham.
Enniskillen Coll.

P. 5627. Portion of presymphysial bone; Kent. *Harford Coll.*

1902. Belonostomus cinctus, M. Leriche, Ann. Soc. Géol. Nord, vol. xxxi. p. 133, pl. iv. fig. 14, text-fig. 4.

1908. Belonostomus cinctus, A. S. Woodward, Foss. Fishes English Chalk (Pal. Soc.), p. 143, pl. xxx. f. 1–7.

Dépt. Nord, France. Santonian; Belgium.

4266. Des? & figd. A.S.W. 1908, p. 145; pl. xxx. fig. 6.

P. 8632. Portions of upper & lower jaws, des? & figd. A.S.W. 1908, p. 143, pl. xxx. fig. 1; Zone of Holaster subglobosus, Dover. Purchased,

P. 10521. Rostrum des? & figd. A.S.W. 1908, p. 143, pl. xxx. fig. 2; Turonian, Whyteleafe, Surrey. Birley Bequest.

P. 10448. Jaws, base of lower median tooth des. & figd. A.S.W. 1908, p. 144, pl. xxx. fig. 5; Southerham, Lewes. Purchased, 1907.

P. 10620. Scales, one dorsal des? & figd. A.S.W. 1908, p. 145, pl. xxx. fig. 7; English Chalk. History unknown.

Belonostomus hooleyi, A.S.W.

1918. Belonostomus hooleyi, A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 100, pl. xxi. figs. 1–3.

Type. Scale; R. W. Hooley Coll.

Form. & Loc. Wealden: I. of Wight; Kent.

28419. Desc. & figs. A. S. W. 1918, p. 100, pl. xxi. fig. 2.

[illegible] Museum of Geneva. (Ann.) Lpzk 1898.

"Belonostomus indicus" = Lepidosteus indicus, see p. 442.

B. matteuzi, dalmaticus, zovaki, spp. n. Cretac. Dalmatia etc. Kramb. Gorj. 1896. Djela Jugosl. Akad. 6 pp. 5– pl. 1.

The following specimens of *Belonostomus* are not specifically determined:—

P. 963 a, P. 3803. A much-elongated small trunk, in counterpart Lithographic Stone, Solenhofen.
Egerton & Enniskillen Colls.

28419. Abraded hinder portion of skull and three fragments of trunk; Wealden, Isle of Wight. The ring-vertebræ are stout, and one appears to be fused with the basioccipital. The small dorsal scales exhibit traces of a rugose ornament. *Mantell Coll.*

P. 7235. Four examples of the hinder half of the skull, noticed in Geol. Mag. [4] vol. ii. (1895), p. 210; Cambridge Greensand, Cambridge. *Jesson Coll.*

P. 7234. Fragment of presymphysial bone; Cambridge Greensand. *Jesson Coll.*

P. 5737. Plaster cast of large fish wanting rostrum, the original obtained by Dr. Anton Fritsch for the Royal Bohemian Museum, Prague; Cretaceous, Island of Lesina, Dalmatia. *Purchased*, 1888.

The following species are not represented in the Collection, and are known only from fragmentary specimens or are imperfectly defined:—

Belonostomus attenuatus, F. Dixon, Geol. Sussex (1850), p. 368, pl. xxxv. fig. 4.—Chalk; Sussex. [Portion of mandible; Brighton Museum.]

Belonostomus genevensis: *Aspidorhynchus genevensis*, F. J. Pictet, Foss. Terrain Néocom. Voirons (1858), pt. iii. p. 42, pls. vi., vii. figs. 1–7.—Neocomian; Voirons, Geneva, Switzerland. [Imperfect trunk.]

(?) *Belonostomus indicus*, A. S. Woodward, Rec. Geol. Surv. India, vol. xxiii. (1890), p. 23.—Upper Cretaceous (Lameta Beds); Dongargaon, Nagpur, India. [Imperfect skull; Geological Society of London.]

(?) *Belonostomus leptosteus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 143, 297 (name only); J. Phillips, Geol. Oxford (1871), p. 180, woodc. xl. fig. 4 (name and fig. only); A. S. Woodward, Ann. Mag. Nat. Hist. [6] vol. i. (1888), p. 355, and Proc. Geol. Assoc. vol. xi. (1890), p. 296.—Bathonian (Stonesfield Slate); Oxfordshire. [Mandibular symphysis; Oxford Museum.]

Belonostomus ornatus, J. Felix, Palæontogr. vol. xxxvii. (1891), p. 192, pl. xxviii. figs. 14–18, pl. xxx. fig. 8.—Neocomian; near Tlaxiaco, Mexico. [Remains of head and scales; Felix Collection, Leipzig.]

Belonostomus pygmæus, T. C. Winkler, Archiv. Mus. Teyler, vol. iii. (1871), p. 173, pl. v. fig. 1.—Lower Kimmeridgian (Lithographic Stone); Eichstädt, Bavaria. [Immature fish; Teyler Museum, Haarlem.]

The fragment of vertebral column from the Cretaceous of Pietraroja, in the University of Naples, described under the name of *Ophirhachis deperditus* by O. G. Costa (Ittiol. Foss. Ital. 1856, p. 14, pl. ii. fig. 4, and Atti Accad. Pontan. vol. viii. 1864, p. 107, pl. ix. fig. 4), may be assigned to *Belonostomus*. The "jaw of *Ophisurus*?" from Pietraroja (O. G. Costa, *ibid.* 1864, Append. p. 126, pl. vi. fig. 6) is also probably a portion of mandible of the same genus. The so-called *Platycerhynchus rhombeus*, O. G. Costa (Atti Accad. Pontan. vol. viii. 1864, p. 98, pl. xi. fig. 3), from Pietraroja, sometimes placed here, is based upon an indeterminable rostrum in the University of Naples.

Family LEPIDOSTEIDÆ.

Head and trunk much elongated, the snout produced, and the abdominal much longer than the caudal region; tail abbreviate-heterocercal. Cranial and facial bones robust and opercular apparatus complete, all more or less ganoid; mandibular suspensorium inclined forwards, but gape of mouth wide; no presymphysial bone in mandible; teeth slender, conical. Branchiostegal rays few. Vertebral centra opisthocœlous. Fins small, the rays branched and articulated distally; fulcra large. Scales rhombic, scarcely, if at all, deepened on the flank.

Genus **LEPIDOSTEUS**, Lacépède.

[Hist. Nat. Poiss. vol. v. 1803, p. 331 (*Lepisosteus*, misprint).]

Rostrum slightly produced in advance of the mandibular symphysis; preoperculum small and displaced far forwards, the suborbitals much divided, and the cleft of the mouth entirely in advance of the eye; maxilla divided into several segments; a single spaced series of large teeth on the margin of the jaw, other teeth comparatively minute; branchiostegal rays spaced, and gular plate wanting. Fulcra biserial on all the fins. Pelvic fins situated about midway

Diphyodus longirostris, L. M. Lambe, Contrib. Canadian Palaeont. vol. iii. pt. ii (1902), p. 30, pl. xv. figs. 18, 19. — U. Cretaceous (Belly River Series); Red Deer River, Alberta. [Portion of rostrum; Victoria Museum, Ottawa.]

Asthirhachis desperditus is referred to Belonostomus crassirostris by G. D'Erasmo, Palaeont. Italica, vol. xxi (1915), p. 1.

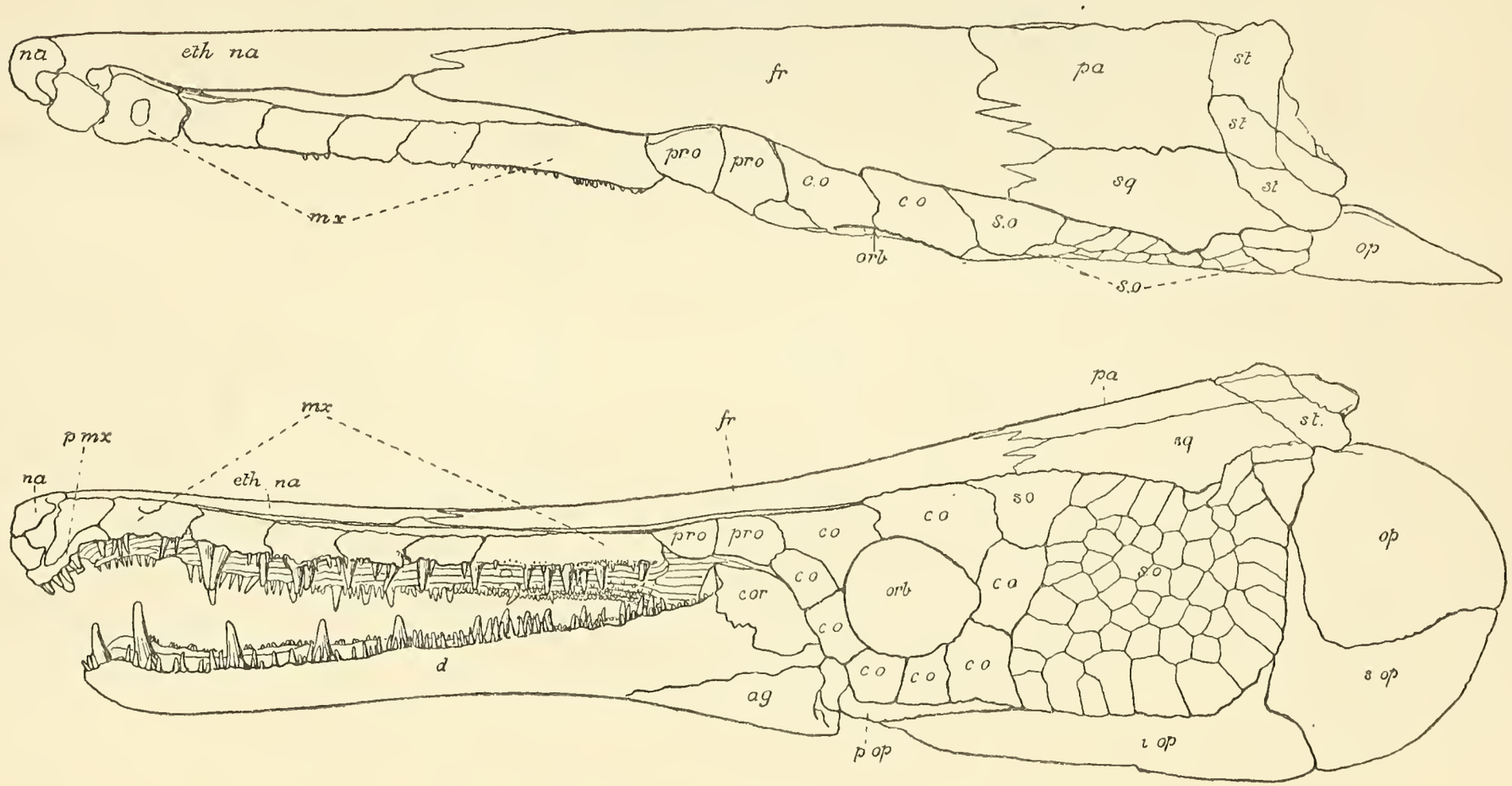
"Lepidotoid" from Muschelkalk of N. Baden L. Rüger, Jahresber. u. Mitteil. des. Oberrhein. geol. Ver. Bd xiii (1923), p. 112 Elf. (? Pro. Semionot.).

Development of Skull, E. Hammarberg, 1937, Acta Zool. Stockholm 18, 209.

L. (pl. scales) from Milk River Beds (U. Cretac.: Alberta) L. S. Russell, 1935, p. 120, pl. ii. f. 2.

C. T. Regan, Proc. Zool. Soc. 1923, p. 445, with figs.

Fig. 43.



Lepidosteus viridis; outline of bones of head of the recent fish, left lateral, and left half of superior aspect.

ag., angular; *c.o.*, circumorbitals; *cor.*, coronoid; *d.*, dentary; *eth.na.*, ethmonasal; *fr.*, frontal; *i.op.*, interopercuium; *mx.*, maxilla; *na.*, nasal; *op.*, operculum; *orb.*, orbit; *p.op.*, preopercuium; *pa.*, parietal; *pmx.*, premaxilla; *pro.*, preorbital; *s.o.*, suborbitals; *s.op.*, suboperculum; *st.*, supratemporals; *sq.*, squamosal. [From a preparation in Central Hall of the Museum.]

between the pectorals and the anal; dorsal and anal fins short-based, remote and more or less completely opposed; caudal fin rounded. Scales robust, the majority with produced anterior angles, and those of the flank not deeper than broad.

Lepidosteus (Clastes) fimbriatus, Wood.

1846. *Lepidosteus fimbriatus,* S. V. Wood, Lond. Geol. Journal, pp. 6, 122, pl. ii. fig. 9.

Type. Fragment of mandible and operculum; British Museum.

An imperfectly definable small species, known only by fragments. External bones ornamented with elongated tubercles of ganoine, usually arranged in more or less radiating series. Operculum slightly deeper than broad, its conspicuous ornament radiating from the antero-superior angle. Scales all smooth, none serrated or fimbriated, except a few narrow scales apparently from the anal region or from the base of the pelvic fins.

The typical operculum measures 0·016 in maximum depth and 0·015 in maximum breadth.

Form. & Loc. ~~Upper Eocene~~ : Hampshire.

L. Headon (Crocodile Beds.)

25252*, 25254*. Right operculum and fragment of dentary, the type specimens figured *loc. cit.*; Hordwell Cliff. The fragment of jaw exhibits the bases of the large teeth in spaced series, with minute teeth on the outer side though none within. *Presented by Searles V. Wood, Esq.*, 1850.

P. 1529 a. Three opercula, one being incomplete, and one sub-operculum; Hordwell. *Egerton Coll.*

P. 1700 a. Associated remains in block of sand, including operculum and portions of jaws; Hordwell. *Egerton Coll.*

P. 1529 b. Numerous head-bones chiefly of this species, but some comparatively large and coarsely marked; Hordwell. *Egerton Coll.*

P. 1529 c. Vertebræ; Hordwell. *Egerton Coll.*

30295. Vertebræ and scales; Hordwell. *Hastings Coll.*

48041 a. Vertebræ; Hordwell. *John Brown Coll.*

P. 1529 d. One complete and two imperfect clavicles exhibiting fine interrupted ridges of ganoine on the outer face; Hordwell. *Egerton Coll.*

Lepidosteus indicus, A.S. Woodw.

1890. Belonostomus(?) indicus, A.S. Woodward, Rec. Geol. Surv. India, vol. xxiii. p. 24.

1908. Lepidosteus indicus, A.S. Woodward, Palæont. Indica, n.s. vol. iii. no. 3, p. 3, pl. i. fig. 8. 9.

Type. Skull; British Museum.

Rostrum very slender, and external bones of cranial roof unusually smooth.

Form. & Loc. Lameta Beds: India.

P. 12178. Type specimen des? & fig? loc. cit. 1908; Dongargaon, Nagpur.

Pres? by Geological Society of London, 1911.

P. 12179. Group of scales, &c.; Dongargaon.

Pres? Geol. Soc., 1911.

Atractosteus lapidosus, O. P. Hay, Proc. U. S. Nat. Mus. vol. 56 (1919), p. 110, pl. xxvi. fig. 4, pl. xxviii. fig. 8. – Pleistocene; Florida.

1936. *Clestes* (sic) *cuneatus*, V. M. Tanner, p. 83, pl. ii. Manti Ba
(? L. Eocene). Utah.

P. 1700 b. Groups of scales in matrix; Hordwell. *Egerton Coll.*

P. 1529 e. Four fimbriated scales, two being in association with the typical smooth scales; Hordwell. *Egerton Coll.*

P. 1529. Various scales and other remains; Hordwell. *Egerton Coll.*

Lepidosteus (**Clastes**) **cuneatus,** Cope.

1878. *Clastes cuneatus,* E. D. Cope, Proc. Amer. Phil. Soc. vol. xvii. p. 9 (name only).

1884. *Clastes cuneatus,* E. D. Cope, Vert. Tertiary Form. West, Book I. (Rep. U.S. Geol. Surv. Territ. vol. iii.), p. 55, pl. i. fig. 6.

Type. Nearly complete fish; ~~Museum of Salt Lake City~~ Amer. Mus. Nat. Hist.

A small species about 0·3 in length, of rather stout proportions. External bones ornamented with radiating lines of tubercles of ganoine, fused into nearly continuous ridges on the operculum and suboperculum. Pelvic fins with long and slender fulcra, arising nearer to the base of the caudal fin than to the end of the snout, which is not much elongated. Scales all smooth, in 18 or 19 longitudinal series.

Form. & Loc. Miocene (Manti Shales); Central Utah, U.S.A.

Not represented in the Collection.

The following fragmentary specimens are not specifically determinable:—

opere. & bone re-registered as Amia P. 13208-9.

28540 a. Three fragments of jaws, a rugose operculum 0·032 in depth, and two other external bones; Bracklesham Beds, Bracklesham Bay, Sussex. The dentary is destitute of minute teeth on its inner border. *Dixon Coll.*

P. 5442. Large vertebral centrum; Bracklesham Beds. *Presented by P. E. Coombe, Esq.*, 1888.

P. 6476. More depressed vertebra; probably Bracklesham. *Beckles Coll.*

P. 2268. Tooth; Bracklesham Beds. *Egerton Coll.*

P. 1532 a. Left operculum; Lower Tertiary, Isle of Wight. *Egerton Coll.*

37201. Scales; Lower Eocene, Dulwich, London. *Presented by R. W. Wolston, Esq.*, 1863.

P. 5504. Scales; Dulwich. *Caleb Evans Coll.*

29017. Scales; Lower Eocene, Kyson, Suffolk.
Presented by Rev. J. Middleton, 1854.

Numerous fragmentary remains of Lepidosteidæ, all too imperfect for specific, and the majority even for generic determination, have also been described under the following provisional names :—

Lepidosteus atrox, J. Leidy, Proc. Acad. Nat. Sci. Philad. 1873, p. 97, and Contrib. Extinct Vert. Fauna W. Territ. (Rep. U.S. Geol. Surv. Territ. vol. i. 1873), p. 189, pl. xxxii. figs. 14, 15. *Clastes atrox*, E. D. Cope, Ann. Rep. U.S. Geol. Surv. Territ. 1872 (1873), p. 634, and Vert. Tertiary Form. West, Book I. (Rep. U.S. Geol. Surv. Territ. vol. iii. 1884), p. 54, pl. ii. figs. 1–24.—Eocene (Bridger Series); Wyoming. [Vertebra.]

Lepidosteus glaber, O. C. Marsh, Proc. Acad. Nat. Sci. Philad. 1871, p. 105. *Clastes glaber*, E. D. Cope, *loc. cit.* 1872 (1873), p. 634.—Eocene; Wyoming. [Scales and vertebræ; Yale College Museum.]

Lepidosteus maximiliani, P. Gervais, Zool. et Pal. Franç. ed. 2 (1859), p. 530; G. Vasseur, Bull. Soc. Géol. France, [3] vol. iv. (1876), p. 301, pl. vi. figs. 1–21. *Lepidotus maximiliani*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1839–44), pp. 9, 268, pl. xxix *c*. figs. 8–11; P. Gervais, Zool. et Pal. Franç. (1848–52), Poiss. Foss., Expl. Pl. p. 2, pl. lxvii. figs. 9–13.—Middle Eocene (Calcaire Grossier); Paris. [Scales.]

Lepidosteus notabilis, J. Leidy, *loc. cit.* 1873, p. 98, and *op. cit.* (1873), p. 192, pl. xxxii. figs. 12, 13.—Eocene (Bridger Series); Wyoming. [Vertebra.]

Lepidosteus simplex, J. Leidy, *loc. cit.* 1873, p. 98, and *op. cit.* (1873), p. 191, pl. xxxii. figs. 18, 26, 31–43.—Eocene (Bridger Series); Wyoming. [Vertebræ, scales, &c.]

Lepidosteus strausi, F. Kinkelin, Ber. Senckenb. nat. Ges. (1884), p. 244, pl. iii. fig. 1; A. Andreae, Verhandl. Nat. Ver. Heidelberg, n. s. vol. v. (1893), p. 7, and Abhandl. Senckenb. nat. Ges. vol. xviii. (1894), p. 355, pl. i. figs. 1–7.—Lower Miocene; Messel, Darmstadt. [Squamation; Senckenberg Museum.]

Lepidosteus (?) *suessionensis*, P. Gervais, Zool. et Pal. Franç. (1848–52), Rept. &c., Explic. Pl. p. 4, pl. lviii. figs. 3–5,

Lepidosteus integer

P. 10512.

Paralepidosteus gen. nov. africanus s.n. Arambourg & Saint Seine 1943 Bull. Soc. géol. Mines A.O.F. p. 42 fig. 3. pls. [illegible] Cret. Niger

?Lepidosteus alessandri, F. Ameghino, Segundo Censo de la República Argentina, vol. i (1898), p. 242. Lepidosteus sp., G. de Alessandri, Atti R. Accad. Sci. Torino, vol. xxxi (1896), p. 726, pl. i. fig. 8. — Tertiary; Parana. [Index Vert.] Ichthyolithosaurodon, Lepidosteus scalabrini. Lepidosteus knieskerni, H. W. Fowler, Bull. Geol. Surv. New Jersey, no. 4 (1911), p. 150, fig. 92. — Cretaceous (?); New Jersey. [Scale; Acad. Nat. Sci. Philad.]

Lepidosteus longus, L. M. Lambe, Contrib. Canad. Palaeont., vol. iii. pt. iv (1908), p. 13, pl. i. figs. 7-9. — Oligocene; Cypress Hills, Saskatchewan. [Vertebra; Canadian Geol. Surv., Ottawa.]

Paralepidosteus praecursor s.n. L. Cret. Congo, S. Casier 1961 Ann. Mus. r. Afr. Cent., Geol. 39: 42 pl. V. f. 2-3 (Vert. remarkable)

1 Eastman, Bull. Mus. Comp. Zool. vol. xxxvi, no. 3; Cockerell, Science, n.s. vol. xxix (1909), p. 796; L. Hussakof & W. L. Bryant, Bull. Buffalo Soc. Nat. Sci. vol. xii (1918), p. 195, pl. 7 xviii.

G. Vasseur, Bull. Soc. Géol. France [3] vol. iv (1876), p. 295 pl. vi. figs. 1–21 (as Lepidosteus maximiliani).
C. H. Leriche, Ann. Soc. Géol. Nord, vol. xxix. (1901), p. 188, & p. pl. ii. figs. 18–41; & Leriche, Mém. Soc. Géol. Nord, vol. v (1906), p. 353; F. Priem, Bull Soc. Géol. France [4] vol. i (1901), p. 489, pl. xi. figs. 1–8. M. Leriche. Mem. Mus roy. Hist. Nat. Belge ii (1902) p. 44 pl. iii

Lepidosteus, M. Leriche, Mém. Soc. Géol. Nord, vol. v (1906), p. 233.

Lepidosteus sp., F. Priem, Poiss. Foss. Bassin Parisien (Bull. Ann. Paléont. 1908), p. 98, pl. ii. fig. 5. — U. Ypresian; Belleu, Aisne, France. [Squamation.]

Clastes lusitanicus, H. E. Sauvage, Bull. Soc. Géol. France [3] vol. xxv (1897), p. . C. l., Carington da Costa 1937, p. 25 (nevoa Beira
H. E. Sauvage 1898. Vert. Foss. Port.: 37 pl. ix f. 1-25, 45. U. Col. Port.

Clastes fusculosus, H. E. Sauvage, loc. cit. 1897.
& loc. cit. 1898 Vert. Foss. Port.: p. 38 pl. ix f. 26-41 U. Col. Port.

Lepisosteus nahuniticus, L. Hussakof, Bull. Amer. Mus. N. H. vol. xxv (1908), p. 79, fig. 41.
Atractosteus lapidosus n.s.

See Trichiurides delheidi, Leriche. Pl. IV, p. 481.
[T. f. S. Ed. Chile, 1931, Vert. Fosiles Cyl. Porcos T. p. 87, pl. 4 f. 3.
Trichiurides sapittidens, E. Wittich, Notizbl. Vereins f. Erdk. Darmstadt, ser. iv. pt. 19 (1898), p. 47, pl. i. fig. 8. [M. Oligocene, Mainz.] See M. Leriche, Mém. Soc. Géol. Nord, vol. v (1906), p. 234, 268; also Mém. Mus. Roy. Hist. Nat. Belg. vol. iii (1905), Poiss. Eocènes Belg., p. 172, where named Lophius sapittidens. Partly referred to Lepidosteus by M. Leriche, Mém. Mus. Roy. Hist. Nat. Belg. vol. ii (1902), Poiss. Paléo. Belg. p. 24. Trichiurides orpiensis, A. Dalmercies, Ann. Soc. Roy. Malac. Belg. vol. xxiii (1888), Bull. Séances, p. xliii (name only). [Heersian; Orp-le-Grand.]
T. O. Leriche 1943. Bull. Mus. r. H.N. Belg. 19 no 35 p. 11 Pl. f. 13-14.

and Comptes Rendus, vol. lxxix. (1874), p. 846; L. Dollo, Bull. Sci. France et Belg. vol. xxv. (1893), p. 193.—Lower Eocene; France. [Portions of jaws; Paris Museum of Natural History.]

Lepidosteus whitneyi, O. C. Marsh, Proc. Acad. Nat. Sci. Philad. 1871, p. 105.—Eocene; Wyoming. [Vertebræ; Yale College Museum.]

Lepidosteus sp., R. Owen, in J. Prestwich, Quart. Journ. Geol. Soc. vol. x. (1854), p. 156, pl. iii. fig. 1.—Lower Eocene (Woolwich and Reading Beds); Upnor, Kent. [Vertebra.]

Lepidosteus sp.: *Lepidotus francottei*, A. Daimeries, Ann. Soc. Malacol. Belg. [2] vol. vii. (1893), Bull. p. xv.—Middle Eocene (Bruxellian); near Brussels. [Scales.]

Clastes anax, E. D. Cope, Ann. Rep. U.S. Geol. Surv. Territ. 1872 (1873), p. 633, and Vert. Tertiary Form. West, Book I. (Rep. U.S. Geol. Surv. Territ. vol. iii. 1884), p. 53, pl. ii. figs. 50–52.—Eocene (Bridger Series); Wyoming. [Cranial bones.]

Clastes cycliferus, E. D. Cope, *loc. cit.* 1872 (1873), p. 634, and *op. cit.* (1884), p. 54, pl. ii. figs. 25–45.—Eocene; Wyoming. [The type species of *Clastes*, founded on cranial bones and scales [1].]

Pneumatosteus nahunticus, E. D. Cope, Proc. Amer. Phil. Soc. vol. xi. (1869), p. 242, and in W. C. Kerr, Rep. Geol. Surv. N. Carolina, vol. i. (1875), Append. p. 31.—Miocene; North Carolina. [The type species of *Pneumatosteus*, founded on a vertebra; Cope Coll.]

Naisia apicalis, G. von Münster, Beitr. Petrefakt. pt. vii. (1846), p. 34, pl. ii. fig. 23; W. Dames, Zeitschr. deutsch. geol. Ges. vol. xxxv. (1883), p. 669.—Upper Eocene; Osterweddingen, Magdeburg. [The type species of *Naisia*, founded on a tooth.]

Trichiurides sagittidens, T. C. Winkler, Archiv. Mus. Teyler, vol. iv. (1876), p. 31, pl. ii. figs. 22, 23; W. Dames, Zeitschr. deutsch. geol. Ges. vol. xxxv. (1883), p. 669.—Middle Eocene (Bruxellian); near Brussels. [The type species of *Trichiurides*, founded on a tooth.]

[1] The generic characters of "*Clastes*" are stated by Cope as follows:—"Mandibular ramus without or with reduced fissure of the dental foramen, and without the groove continuous with it in *Lepidosteus*. One series of large teeth, with small ones exterior to them in the dentary bone, the inner superior aspect of that bone without prominent dentiferous or rugose rib."

Suborder IV. *ISOSPONDYLI.*

Notochord varying in persistence, the vertebral centra usually complete, but none coalesced; tail homocercal, but hæmal supports not much expanded or fused. Symplectic bone present; mandible simple, each ramus consisting only of two elements (dentary and articulo-angular), with rare rudiments of a splenial on the inner side. Pectoral arch suspended from the cranium; a precoracoid arch present, infraclavicular plates wanting; pectoral fin with not more than four or five basals. Pelvic fins abdominal. Scales ganoid only in the less specialized families. In the living forms—air-bladder connected with the œsophagus in the adult, optic nerves decussating, and intestine either wanting spiral valve or with an incomplete representative of it.

Synopsis of Families (*contained in Part III.*).

I. Margin of upper jaw formed by maxilla and premaxilla; parietal bones in contact mesially.

Vertebral centra not more than rings; no fused or expanded hypurals; no intermuscular bones; fins fringed with fulcra; scales rhombic and ganoid ..... PHOLIDOPHORIDÆ (p. 446).

Vertebral centra complete or with minute perforation; no fused or expanded hypurals; intermuscular bones rare or absent; fins fringed with fulcra; scales cycloidal ..... OLIGOPLEURIDÆ (p. 490).

Vertebral centra nearly complete, but with perforation; no fused or expanded hypurals; intermuscular bones well-developed; no fulcra on fins; scales cycloidal, but ganoid ..... LEPTOLEPIDÆ (p. 500).

(*To be continued in Part IV.*)

Family PHOLIDOPHORIDÆ.

Trunk elegantly fusiform. Head with delicate membrane-bones, the suborbital and circumorbital plates completely covering the cheek, all enamelled; snout not produced; mandibular suspensorium nearly vertical or inclined forwards, and gape of mouth wide; premaxilla very small; maxilla large, loosely attached and with two well-developed supramaxillary plates; teeth small and conical. Opercular apparatus complete. Vertebral centra never advanced

Phylogeny of Isospondyli, W.K. Gregory & G. Miltonran. 1936, Copeia, no1. p. 121.

On the splenial see E. C. Starks, "The Sesamoid Articular, a Bone in the Mandible of Fishes," Leland Stanford Junior Univ. Publ., Univ. Series, March 31, 1916.

scutigerum, n.g.n.
Pholidopleron (Huxley Q.J.G.S. XXV, 1869, 310)
"just Telest"; D.M.S. Watson P.Z.S. 1925, 866.
He probably meant. Pholidosphenus.

Pholidophoridae S. Sk. diagnosis Nybelin, 1966,
Bull. BMNH Geol. II: 425

Plectodophous (error) de Zigno 1894 Atti. R. Acad. Linc. Roma (1891) Mem VII, p. 53 (*M. capitalus*, ? *dorsalis*, ? *platiscutus*, ? *punctus*).

See A.S.W. 1961 A.m.n.H. (11) 8 p. 88.
Diagnosis Nybelin 1966, Bull. BMNH Geol. 11: 356

beyond the annular stage; ribs delicate; no fused or expanded hæmal arches at the base of the tail. Intermuscular bones absent. Fin-fulcra present, but usually small; dorsal and anal fins small, the former above or behind the pelvic fins. Scales ganoid, more or less rhombic, but deeply overlapping, and the hinder margin often somewhat rounded.

Synopsis of Genera.

I. Flank-scales united by peg-and-socket, not excessively deepened.
  Pectoral and pelvic fins small; dorsal in advance of anal ..... *Pholidophorus* (p. 447).
  Pectoral fins greatly enlarged, and pelvic fins small; dorsal opposed to anal ..... *Thoracopterus* (p. 478).
II. Flank-scales united by peg-and-socket, one series excessively deepened.
  Pelvic fins absent; dorsal opposed to anal; ventral scales broader than deep; lateral line along deepened scales ..... *Pholidopleurus* (p. 479).
  Pelvic fins small; dorsal in advance of anal; ventral scales as broad as deep; lateral line along deepened scales ..... *Peltopleurus* (p. 481).
  Pelvic fins small; dorsal opposed to anal; ventral scales about as broad as deep; lateral line deflected to upper series of ventral scales ..... *Pleuropholis* (p. 482).
III. Flank-scales not united by peg-and-socket, not excessively deepened.
  Pectoral and pelvic fins of moderate size; dorsal and anal opposed; scales thin .. *Archæomæne* (p. 488).
IV. Flank-scales unknown.
  Fins with long slender fulcra, and dorsal in advance of anal; large caudal ridge-scales ..... *Ceramurus* (p. 489).

Genus **PHOLIDOPHORUS,** Agassiz.

[Neues Jahrb. 1832, p. 145.]

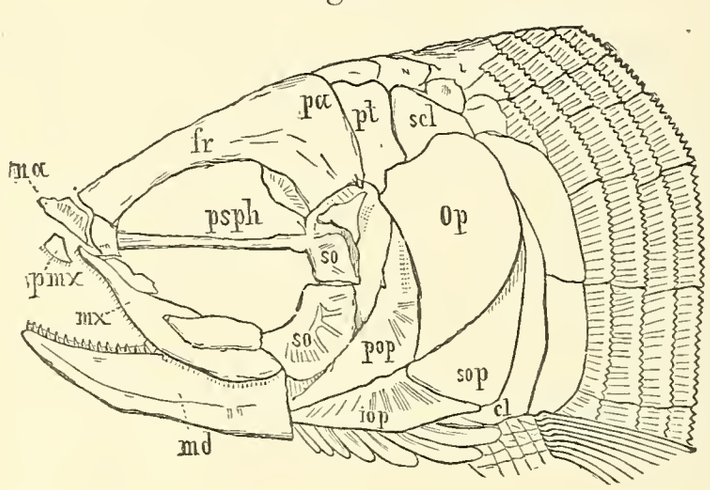
Syn. (?) *Microps*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1833, p. 10.

Trunk not much deepened, and head relatively large. External bones smooth or delicately ornamented with rugæ and tuberculations; sensory canal on suborbital and preorbital plates branched; maxilla more or less arched, the oral margin convex and provided with minute teeth; mandibular teeth larger, but still minute and arranged in a single series. Preoperculum broad mesially and marked with slight radiating furrows; suboperculum large, but

smaller than the trapezoidal operculum, from which it is divided by an oblique suture; branchiostegal rays numerous. Pleurocentra and hypocentra in notochordal sheath fused or separate. Fin-fulcra small, extending along the foremost ray of each of the fins. Pectoral not excessively large, but much exceeding the pelvic fins in size; dorsal and anal fins triangular in shape, not extended, the former opposite or arising somewhat behind the pelvic fins; caudal fin deeply forked. Scales thin, deeply overlapping, usually with an inner rib and peg-and-socket articulation, and the external layer of ganoine smooth or feebly ornamented; principal flank-scales deeper than broad, ventral scales in part broader than deep; no enlarged series of ridge-scales, but a large scale at the base of one or both lobes of the caudal fin, and three slightly enlarged scales round the anus at the base of the anal fin. Lateral line opening by widely separated large pores.

Little can be added to the osteological characters of this fish noted in the generic diagnosis. In the axial skeleton of the trunk the pleurocentra and hypocentra are delicate, always directly

Fig. 44.



Head, etc., of *Pholidophorus macrocephalus*, left lateral aspect (after Zittel).

cl., clavicle; *fr.*, frontal; *i.op.*, interoperculum; *md.*, mandible; *mx.*, maxilla; *na.*, nasal; *op.*, operculum; *pa.*, parietal; *pmx.*, premaxilla; *pop.*, preoperculum; *psph.*, parasphenoid; *pt.*, supratemporal; *scl.*, "supraclavicle" (? post-temporal); *so.*, suborbital; *sop.*, suboperculum.

opposed, not alternating; but it is difficult to determine whether or not they usually fuse into complete rings. In the abdominal region, the two halves of each neural arch appear to be separate from each other and from the spine they support; while the ribs are delicate and extend only about half-way to the ventral border. The remote situation of the anus is indicated not merely by the enlarged median and paired scales surrounding it, but also by coprolitic matter in

Skull, reconstruction, D. H. Rayner 1944,
Biol. Rev. 16. p. 230 fig. 10. 1948, Pk. Tr. R.S.
233 B. p. 318 figs 25-29.

some specimens. The right and left halves of the rays in the dorsal and anal fins are very loosely apposed, and their frequent displacement in the fossils renders it difficult to count them.

The characters of *Pholidophorus* are remarkably constant throughout the Jurassic period, but most of the later species are more elaborately ornamented than those of earlier date. Some of the distinctive features of the species described below are enumerated in the following synopsis:—

I. Scales not serrated.

- Length of head slightly less than maximum depth of trunk and contained five times in total length; dorsal opposite pelvic fins; scales large and smooth, scarcely convex border, four deepened series ..... *bechei* (p. 450).
- Stouter, with relatively larger scales .... *pachysomus* (p. 453).
- Smaller, differing in larger size of head which equals about one quarter of the total length ..... *latiusculus* (p. 454).
- More slender; head occupying one-fifth; dorsal arising behind pelvic fins; scales thinner, with convex hinder border ..... *stricklandi* (p. 456).
- Somewhat stouter and head smaller; dorsal opposite pelvic fins; scales very thin, none much deeper than broad .. *caudalis* (p. 457).
- Head occupying one-fifth; dorsal opposed to pelvic fins; scales coarsely but feebly rugose, and about six series deepened ..... *germanicus* (p. 459).
- Head occupying one-fourth; dorsal arising behind pelvic fins; fulcra remarkably large; scales smooth, four series much deepened, especially that of lateral line ..... *purbeckensis* (p. 460).

II. Scales serrated.

- Head occupying one-fourth; dorsal opposed to pelvic fins; sparse denticulations on the four deepened flank-series of scales..... *higginsi* (p. 461).
- Very slender, and head occupying one-fifth; dorsal arising behind pelvic fins; scales scarcely deepened, partly ridged along lines of growth, and serrations coarse ..... *crenulatus* (p. 463).
- Stouter, with larger head; scales smooth and more finely serrated, five series deepened on flank ..... *limbatus* (p. 464).

Head larger and trunk more slender; dorsal opposite pelvic fins; six deepened series of flank-scales, with fine serrations ..... *hartmanni* (p. 466).
Length of head slightly less than maximum depth of trunk, which is contained four times in total length; dorsal opposite pelvic fins; scales very finely pectinated and serrated, with inconspicuous lateral line ..... *macrocephalus* (p. 467).
Smaller and more slender, with smaller head ..... *similis* (p. 470).
Maximum depth of trunk equalling one-third of total length; dorsal opposite pelvic fins; scales very finely pectinated and serrated, with inconspicuous lateral line ..... *granulatus* (p. 470).
Smaller and probably more slender ..... *ovatus* (p. 471).
Length of head much less than maximum depth of trunk, which is contained four times in total length; dorsal opposite pelvic fins; scales coarsely pectinated, and lateral line a ridge on caudal region ..... *ornatus* (p. 471).
Smaller and more slender ..... *micronyx* (p. 473).

III. Incertæ Sedis, the dorsal fin opposed in great part to anal fin.

Length of head equalling maximum depth of trunk and contained $4\frac{1}{2}$ times in total length; four deepened series of flank-scales ..... *gregarius* (p. 474).
Smaller head; maximum depth of trunk one-third total length; three deepened series of flank-scales ..... *dubius* (p. 474).

Pholidophorus bechei, Agassiz.

[Plate XII. figs. 1, 2.]

1822. "Fossil Fish," H. T. De la Beche, Trans. Geol. Soc. [2] vol. i. p. 45, pl. vii. fig. 1.
1844. *Pholidophorus bechei*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 272, pl. xxxix. figs. 1–4.
1844. *Pholidophorus onychius*, L. Agassiz, *ibid.* p. 274, pl. xxxix. figs. 5–7. [Nearly complete fish; Oxford Museum.]

Type. Nearly complete fishes.

The type species, attaining a length of about 0·2. Length of head with opercular apparatus somewhat less than the maximum

Huenglichthys cranii gen. et sp. nov. M. Jurassic
Sinkiang, H. Liu & T. Wang. Acta Pal. Sinica 9
266, 1 pl.

? = P. [illegible]

1967 Pholidolepis d. asterensis, R. Lund, Amls Carnegie Mus., 39, no 15: figs 1, 2 (errou)
1967 P. b., R. Lund, Amls Carnegie Mus., 39, no 15: fig. 11
1966 P. b., R. Lund, Science, 153: 348, figs 1, 2
1966 P. b. O. Nybelin, Bull. BMNH geol. 11: 357, pls 1-3, figs 1-2.
1952. P. b. B. Haug [illegible] p. 25 pl. 58 f a.
1896. Pholidophorus bechei, H. Scupin, Archiv f. Naturgesch. vol. i. p. 169, pl. x. f. 4 [structure of scale].
1924. Pholidophorus ex. aff. bechei. L. Rüger, Centralblatt für Min. No 23, Dresden, p. 729 f. 4. (L. Lias; Baden).
1948. P. b. D-H. Rayner Ph. Tr. R. S. 233 B. p. 318 figs 24-29 (cranium reconstruction 2 figs).

depth of the trunk, and occupying one-fifth of the total length of the fish. The rugose ornament of the head and opercular bones very feeble and often in radiating lines; maxilla and dentary marked with fine, prominent, irregular longitudinal striations. Fulcra minute on all fins except the caudal, on which they are larger. Pectoral fins with about 18 rays and larger than the pelvic fins, which have 14 rays and arise considerably in advance of the middle point of the trunk; dorsal fin with about 12 rays, directly opposed to the pelvic pair. Scales large and smooth, the hinder margin not serrated and very slightly convex; four longitudinal flank-series much deeper than broad.

Form. & Loc. Lower Lias: Dorsetshire.

All the following specimens were obtained from the neighbourhood of Lyme Regis:—

25276–77. Two imperfect and distorted fishes about 0·17 in length. *Purchased*, 1850.

28281. An equally large specimen, displaying the left lateral and partly ventral aspect. *Purchased*, 1853.

32403. Fine specimen 0·16 in length, partly crushed and fractured but showing portions of all the fins. *Purchased*, 1857.

38162, 39836. One smaller and one larger fish, somewhat elongated by crushing. In the second specimen the depth of the very small dorsal fin is shown. *Purchased*, 1864, 1866.

P. 3586 a–e. Five large and well-preserved specimens, three displaying the general proportions of the fish, the two others more distorted. The second fossil exhibits some flank-scales with the articulating peg as robust as described by Agassiz in *P. bechei*, and others with this peg as long and slender as in the so-called *P. onychius*. *Enniskillen Coll.*

P. 1052 a–g, P. 1051. Seven imperfect specimens, of large or moderate size. In the first fossil the dorsal and pelvic fins are displayed, the former with a few minute fulcra, the latter without fulcra. *Egerton Coll.*

P. 3586 f. Fish about 0·155 in length. *Enniskillen Coll.*

39858. A similar fish, vertically cleft and displaying the well-preserved squamation of both sides. The right side of the specimen is shown, of the natural size, in Pl. XII.

fig. 1, and the apparent depth of the trunk is increased by the extension of the dorsal and ventral squamation. One of the pectoral fins is fringed with minute fulcra.
Purchased, 1866.

39857. Ventral aspect of an equally large specimen, showing the paired fins without fulcra. *Purchased*, 1866.

38107–9. A somewhat smaller fish and two distorted specimens. The first exhibits at least 10 branchiostegal rays on the right side, and also the small triangular premaxilla ; the third shows minute fulcra on the right pelvic fin.
Purchased, 1864.

P. 1051 a. Well-preserved fish 0·13 in length, distorted by crushing ventrally. *Egerton Coll.*

21504. Distorted fish. *Purchased*, 1847.

P. 6030. Fish 0·12 in length, imperfectly preserved but apparently not distorted. *Presented by George Clifton, Esq.*, 1889.

38535. Slightly smaller fish, distorted ventrally. *Purchased*, 1864.

P. 3587. Another similar specimen, labelled "*Pholidophorus onychius*, Ag.," in Agassiz' handwriting, but exhibiting flank-scales with pegs as stout as those supposed to characterize *P. bechei*. *Enniskillen Coll.*

P. 3588, P. 3589 a–c. Four specimens from 0·11 to 0·067 in length, the first labelled "*Pholidophorus latiusculus*, Ag.," in Agassiz' handwriting, the third especially well-preserved in side view and showing much variation in the length and stoutness of the articular pegs of the flank-scales (Pl. XII. fig. 2). *Enniskillen Coll.*

36473–74, 37372, 37377. Three small individuals and one 0·14 in length, all distorted. *Purchased*, 1862–63.

P. 153–4. Two small distorted specimens. *Purchased*, 1880.

39859. Fish 0·075 in length, deepened anteriorly by crushing.
Purchased, 1866.

19010. Imperfect pyritized specimen, probably of this species, showing ring-vertebræ in the caudal region.
Purchased, 1844.

Pholidophorus pachysomus, Egerton.

[Plate XII. fig. 3.]

1852. *Pholidophorus pachysomus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv.), no. 4, pl. iv.

Type. Imperfect distorted fish; British Museum.

A species (? or variety) differing only from *P. bechei* in its stouter proportions and the relatively larger size of the scales. Maximum depth of trunk contained not more than three-and-a-half times in the total length of the fish.

Egerton's statement that the scales of the lateral line number only 30 is founded upon the type specimen, which is proved by later specimens to be imperfect. As in *P. bechei*, the number of transverse series of scales in *P. pachysomus* is approximately 40.

Form. & Loc. Lower Lias: Dorsetshire.

The following specimens were all obtained from the neighbourhood of Lyme Regis:—

P. 571. Type specimen, much fractured, crushed and distorted. *Egerton Coll.*

28281. Fish about 0·17 in length and 0·045 in maximum depth, with imperfect head, shown in Pl. XII. fig. 3. *Purchased*, 1853.

35557. Smaller and more imperfect fish, exhibiting minute fulcra on the right pelvic fin. *Purchased*, 1858.

39855. Fine specimen 0·165 in length, with remarkably narrow caudal pedicle. *Purchased*, 1866.

P. 1049 a, b, P. 1052. Three imperfect crushed and fractured specimens. *Egerton Coll.*

36475. Distorted fish. *Purchased*, 1862.

P. 1049 c, d. Two specimens showing remains of the head and abdominal region. *Egerton Coll.*

38740. Small imperfect fish 0·1 in length, probably referable to this species. *Purchased*, 1865.

A fish not yet clearly distinguished from *P. pachysomus* also occurs in the Upper Lias of Würtemberg, and has already been noticed by Quenstedt (Handb. Petrefakt. 1852, p. 207, pl. xvii. fig. 15, and Der Jura, 1858, p. 234). The following are examples of this form:—

18510–11. Much-fractured specimen in counterpart; Upper Lias, Ohmden, Würtemberg. The head with opercular apparatus is contained more than four times, and the maximum depth of the trunk much less than four times in the total length, which measures about 0·15. The cranial roof and mandibular ramus are shown to be coarsely rugose. The dorsal fin is opposed to the pelvic pair. The scales are all smooth, not serrated, while those of the flank are much deepened. *Purchased*, 1844.

P. 7579. More imperfect specimen, wanting the head; Ohmden. *Egerton Coll.*

Pholidophorus latiusculus, Agassiz.

[Plate XIV. fig. 3.]

1832. *Pholidophorus latiusculus*, L. Agassiz, Neues Jahrb. p. 145.
1833–44. *Pholidophorus latiusculus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 9, 287.
1844. *Pholidophorus fusiformis*, L. Agassiz, *ibid.* p. 288 (name only). [Fish; British Museum.]
1850. *Semionotus curtulus*, O. G. Costa, Atti Accad. Pontan. vol. v. p. 294, pl. vii. fig. 6, pl. viii. fig. 2 (*non* pl. vi. figs. 4, 5).
1853. *Semionotus curtulus*, O. G. Costa, *loc. cit.* vol. vii. p. 9, pl. i. fig. 5.
1866–67. *Pholidophorus latiusculus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. p. 328, pl. iii. figs. 2, 3, and *ibid.* vol. lvi. pt. i. p. 903, pl. ii. fig. 1.
1892. *Pholidophorus latiusculus*, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, p. 23.

Type. Nearly complete fish.

A small species, attaining a length of about 0·08. Length of head with opercular apparatus at least equalling the maximum depth of the trunk, and occupying about one-quarter of the total length of the fish. The rugose ornament of the head and opercular bones feeble; maxilla longitudinally striated. Pelvic fins arising considerably in advance of the middle point of the trunk, opposite the origin of the dorsal fin. Scales large and smooth, the hinder margin very slightly convex and not serrated; several flank-series deeper than broad.

The small specimens of *Pholidophorus* from the Lower Lias of Lyme Regis, Dorsetshire, ascribed to *P. latiusculus* by Agassiz (1844) are now catalogued as young individuals of *P. bechei* (*supra*, p. 450). It may also be added that in the two first drawings

1896. Ph. lat. F. Bassani, Pal. Ital. 1 p. 203 pls. figs.

1905. Ph. lat. K. G. Krambergen, Beitr. Pal. Osten.-Ungarn XVIII. p. 221, t-f. 19, pl. xx (iv) f. 9. [incl. S. cuniculus].

[?] 1910. Pholidophorus latiusculus, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 126

1914. Phol. latiusculus, F. Bassani, Rendic. R. Accad. Lincei, Cl. Sci. Phys. &. [5] vol. xxiii. p. 380, with text-fig. [Gulf of Spezia.] = Ph. caffii, fide Zambelli, 1975:14
See also Fossilium Catalogus. pars. 33.

1937. Phol. latiusculus, A. Bonio, p. 652, pl. iv. f. 4, v. 3. t-f. 9, 10, = Ph. caffii, see Zambelli 1975: 14

1966 P. l. O'Nybelin Bull. Brit. Mus. geol. 11: 368, pls 4, 5, 15, figs 3, 4

Ph. pus. F. Banani 1856 Pal. Ital. 1 p. 205 pl. figs.

Ph. cf. *pusillus* Ag. O. Ny Lelin 1966, Bull BMNH Geol 11: 382, pl. 6 t-f

of *P. latiusculus* published by Kner, the arrangement of the scales is inaccurately shown.

Form. & Loc. Upper Trias: Seefeld, Tyrol; Giffoni, Prov. Salerno, Italy.

21382. Head and trunk nearly 0·08 in length, not much distorted, but showing only fragments of the paired and caudal fins; Seefeld. *Purchased*, 1847.

33987–88. Two slightly smaller distorted specimens, one in counterpart; Seefeld.
Presented by Sir R. I. Murchison, K.C.B., 1860.

21385–87. Three smaller distorted fishes; Seefeld.
Purchased, 1847.

P. 1059, P. 1063. Five specimens, variously imperfect; Seefeld.
Egerton Coll.

P. 3590, P. 4417–18. Five specimens, variously imperfect; Seefeld.
Enniskillen Coll.

33990. Large imperfect specimen, doubtfully of this species; Seefeld. *Presented by Sir R. I. Murchison, K.C.B.*, 1860.

P. 516. Small fish shown of the natural size in Pl. XIV. fig. 3, intended to be the type specimen of *Pholidophorus fusiformis*, Agassiz, *loc. cit.*; labelled "Castellamare," but evidently from the black shale of Giffoni. *Egerton Coll.*

The following small specimens are of the form named *Pholidophorus pusillus* by Agassiz (Neues Jahrb. 1832, p. 146, and Poiss. Foss. vol. ii. pt. i. 1833–44, pp. 9, 287), and subsequently described by R. Kner (Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liv. pt. i. 1866, p. 330, pl. vi. fig. 2), but are not clearly distinguished from *P. latiusculus* [1]:—

21390–91. Two small slabs with several contorted and crushed fishes, too imperfect to determine their form and proportions; Upper Trias, Seefeld, Tyrol. The apparent slenderness of these specimens depends upon the mode of crushing. *Purchased*, 1847.

[1] Other specimens from the Upper Trias of Lumezzane, Lombardy, are also recorded under the name of *Pholidophorus pusillus* by W. Deecke, Palæontogr. vol. xxxv. (1889), p. 136. Others appear to be included under the name of *Semionotus curtulus* by O. G. Costa, Atti R. Accad. Sci. Napoli, vol. vi. Append. (1862), p. 44, pl. vii. fig. 1 (F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, pp. 12, 22).

P. 3585. Another slab; Seefeld. *Enniskillen Coll.*

P. 5989-91. Three imperfect specimens from 0·04 to 0·05 in length, the first in counterpart. Upper Keuper, Lunz, Austria. *Purchased*, 1889.

Pholidophorus stricklandi, Agassiz.

[Plate XIII. fig. 1.]

1844. *Pholidophorus stricklandi,* L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 284, pl. xlii. *a.* figs. 3,4.

Type. Nearly complete fish; *olim* H. E. Strickland Collection.

A species of small size, attaining a length of about 0·12, of slender and graceful proportions, the dorsal much less arcuated than the ventral border. Length of head with opercular apparatus somewhat exceeding the maximum depth of the trunk, which equals about one-fifth of the total length of the fish. Pelvic fins arising considerably in advance of the middle point of the trunk, and the dorsal fin immediately behind. Scales large and smooth, the hinder margin convex and not serrated; four longitudinal flank-series much deeper than broad.

Form. & Loc. Lower Lias: Leicestershire and Somersetshire.

25407–8. A typical specimen slightly elongated by crushing, in counterpart; Glastonbury, Somersetshire. The fish is shown, of the natural size, in Pl. XIII. fig. 1, and exhibits all the principal characters of the species. In the counterpart, the fulcra on the dorsal and pelvic fins are conspicuous. *Cunnington Coll.*

P. 1057. Head and abdominal region of large fish; Street, Somersetshire. The longitudinally striated maxilla is shown, and there are traces of a feeble ridged ornament on part of the cranial roof. *Egerton Coll.*

P. 3593. Another large specimen, much fractured and wanting the paired fins; Barrow-on-Soar, Leicestershire. *Enniskillen Coll.*

18387, 18390–a. Scattered remains of three fishes of moderate size, the second exhibiting partially calcified ring-vertebræ; Barrow-on-Soar. *Presented by Edward Charlesworth, Esq.*, 1844.

19859, 19861. Distorted fish about 0·075 in length, and the caudal half of a similar specimen; Barrow-on-Soar. *Purchased*, 1846.

Original of Agass. pl. xTii a, fig. 4, from Binton, Warwickshire, in Sedgwick Mus, Cambridge.

Pholidophoropsis n.g. O Nybelin, 1966, Bull BMNH Geol., 11: 411. Type-species P. caudalis Woodward

1911. Pholidophoroides? caudalis A.S.W. A.M.N.H. (11) 8 p. 90.

1966 Pholidophoropsis caudalis (Woodward), Nybelin, Bull. BMNH, Geol. 11: 411, pl 13, ff. 13.

21334. Fragmentary remains of a similar fish; Barrow-on-Soar. *Purchased*, 1847.

25409. A somewhat larger individual; Glastonbury. *Cunnington Coll.*

36312. A smaller specimen, partly disturbed and distorted; Barrow-on-Soar. *Presented by Miss Wilson*, 1862.

P. 3593 a. Imperfect fish nearly 0·075 in length; Barrow-on-Soar. *Enniskillen Coll.*

P. 1055–6. Five specimens varying in size and state of preservation; Barrow-on-Soar. *Egerton Coll.*

P. 1056 a. Part of the head and abdominal region of a large fish, showing the striation of the maxilla and the comparative smoothness of the cranial roof and opercular bones; Barrow-on-Soar. *Egerton Coll.*

? oides
Pholidophorus caudalis, sp. nov.

[Plate XVIII. figs. 1, 2.]

1844. *Leptolepis caudalis*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 133 (undefined).

Type. Nearly complete fish; British Museum.

A slender species, attaining a length of about 0·13. Length of head with opercular apparatus somewhat exceeding the maximum depth of the trunk, and contained about four-and-a-half times in the total length of the fish. External rugose ornament very feeble, the maxilla marked with few longitudinal striations. Pelvic fins arising considerably in advance of the middle point of the trunk, but nearer the anal than to the pectorals, and the dorsal fin arising directly opposite. Scales remarkably thin, the hinder margin convex and not serrated; no flank-series, much deeper than broad.

Form. & Loc. Lower Lias: Dorsetshire.

All the following specimens were obtained from the neighbourhood of Lyme Regis:—

P. 3664. The type specimen, shown of the natural size in Pl. XVIII. fig. 1. The head is obliquely crushed, showing part of the cranial roof and the left side. All the opercular elements are distinct, and there appear to be traces of enlarged postclavicular scales. The ossifications in the

notochordal sheath are obscurely indicated, and the delicate ribs in the abdominal region are displaced. The position of the dorsal fin is indicated by its supports, about 13 in number, while the anal fin, showing 11 supports, arises opposite its hinder end. The caudal fin is distinctly forked and exhibits some of the fulcra on its inferior margin. The incomplete left pectoral fin is exposed, and both pelvic fins, with their supports, buried in the delicate squamation. *Enniskillen Coll.*

43055. Another fine specimen, displaying the fulcra on the pelvic and caudal fins. The form of some of the abdominal scales is also well shown. *Purchased*, 1871.

35561–62, 35725. Three imperfect and distorted small specimens, displaying the delicate though completed ring-vertebræ in the caudal region, and the stout hæmal spines supporting the caudal fin. *Purchased*, 1858–59.

38163–64, 38536–37. Four small specimens, variously imperfect. *Purchased*, 1864.

39862, 39871. A similar specimen and a larger fish, the latter exhibiting 13 rays in the dorsal fin and remains of the fulcra on the pectoral and caudal fins. *Purchased*, 1866.

43007. Fish elongated by distortion. *Purchased*, 1871.

P. 939, a–c. Four imperfect specimens, two being labelled "*Leptolepis caudalis*" by Agassiz. *Egerton Coll.*

P. 3662, P. 3664 a, P. 4370. Seven imperfect specimens, one shown of the natural size in Pl. XVIII. fig. 2. *Enniskillen Coll.*

P. 6067. Small fish displaying separate pleurocentra and hypocentra in the abdominal region, delicate ring-vertebræ in the caudal region. *Presented by F. Harford, Esq.*, 1889.

The following specimens may perhaps be unusually large examples of *P. caudalis*, but are too imperfect for certain determination:—

P. 899 a, b. Imperfect fish, originally about 0·185 in length, showing minute fulcra on the median fins, also a distorted specimen; Lyme Regis. *Egerton Coll.*

Pholidophoropsis maculata O. Nybelin, 1966, Bull. BMNH Geol. 11: 416, pl. 14, figs. 14, 15. 43055 holotype

Pholidolepis O Nybelin 1966, Bull. BMNH Geol. 11: 387
type species P dorsetensis Nybelin

38164 - holotype of P. dorsetensis Nybelin 1966
Bull BMNH Geol. 11: 387, pl. 7, figs. 7, 8.

1895. *Pholidophorus germanicus*, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. XIII. p. 30, pl. iv. figs. 1–5.

1908. *Pholidophorus* aff. *germanicus*, F. Priem, Poiss. Fos. Bassin Parisien (Publ. Ann. Paléont.), p. 17, pl. i. fig. 3.

1935. *Pholidophorus germanicus*, C. Arambourg, p. 25. pl. iii f. 3.

1952. *P. g.* B. Kauffs Das Holzmadenbuch p. 25. pl. 67 f. 6. (Gonna. Mans.)

P. 4232. Scattered remains of a similar fish ; Lyme Regis. Fulcra are seen on the pelvic, dorsal, and caudal fins, but none of the scales appear to indicate a peg-and-socket articulation. *Enniskillen Coll.*

P. 3702 a. Specimen deepened in abdominal region and with fragmentary head ; Lyme Regis. *Enniskillen Coll.*

Pholidophorus germanicus, Quenstedt.

1858. *Pholidophorus germanicus,* F. A. Quenstedt, Der Jura, p. 234, pl. xxx. figs. 9–11.

1891. *Pholidophorus germanicus,* A. S. Woodward, Geol. Mag. [3] vol. viii. p. 545.

Type. Nearly complete fish ; Tübingen University Museum.

A large species, attaining a length of about 0·3. Length of head with opercular apparatus somewhat exceeding the maximum depth of the trunk, which equals about one-fifth of the total length of the fish. The rugose ornament of the head and opercular bones very fine, but conspicuous ; maxilla and dentary longitudinally striated. Pelvic fins arising slightly in advance of the middle point of the trunk, with the dorsal fin directly opposed. Scales large and nearly smooth, but with a faint, coarse rugosity, most conspicuous in the caudal region ; their hinder margin is very slightly convex and not serrated ; at least six longitudinal flank-series much deeper than broad.

Form. & Loc. Upper Lias : Würtemberg ; and Yorkshire. (?) Normandy. Jonas, Fran.

P. 7580. Imperfectly preserved fish about 0·24 in length, with the head-bones scattered ; probably from Ohmden, Würtemberg. The conspicuous rugose ornament of the cranial roof and the radiating folds on the angle of the preoperculum are shown ; and a portion of the squamation is well exhibited. *Old Collection.*

P. 7581. Equally large fish more imperfect and abraded ; probably from Ohmden. *Old Collection.*

P. 1065. Another distorted specimen, wanting the fins and with much abraded squamation ; Ohmden. *Egerton Coll.*

P. 4405. Smaller imperfect, partly distorted and abraded specimen, showing portions of all the fins except the caudal ; Ohmden. *Enniskillen Coll.*

P. 1065 a, b, c. Two imperfect portions of head and trunk, and a much fractured specimen 0·23 in length ; Ohmden. *Egerton Coll.*

19653. A small fish wanting the cranium and the greater part of the fins, but displaying the squamation ; Boll, Würtemberg. *Purchased*, 1845.

P. 1058. Imperfect hinder half of fish ; Whitby, Yorkshire. Fulcra are distinctly observed on the pelvic fin. *Egerton Coll.*

P. 4412. Much abraded and fractured specimen, about 0·235 in length, showing the general proportions of the fish ; Whitby. *Enniskillen Coll.*

P. 1058 a–c. Two portions of the head and abdominal region, and an imperfect fish showing the ventral aspect ; Whitby. Portions of the ornament of the head and opercular bones are well exhibited. *Egerton Coll.*

P. 4406. Posterior abdominal and caudal region ; Whitby. *Enniskillen Coll.*

P. 3704. Head and anterior flank-scales, probably of this species ; Upper Lias, Ilminster. The rugæ of the dentary and maxilla, so far as shown, are less regularly longitudinal than usual ; while those of the anterior flank-scales are arranged in slightly radiating striations towards the hinder border. The roof of the skull exhibits the parietals and frontals, and the wavy median suture ; while the branching sensory canal is distinct on the lower posterior suborbital plate. *Enniskillen Coll.*

32452. Caudal pedicle and fin, probably of this species ; Upper Lias, Caen, Normandy. *Tesson Coll.*

Ichthyokentema

~~Pholidophorus~~ purbeckensis, (Davies.)

1887. *Pholidophorus purbeckensis*, W. Davies, Geol. Mag. [3] vol. iv. p. 337, pl. x. figs. 2–4.

1887. *Pholidophorus brevis*, W. Davies, *ibid.* p. 338, pl. x. fig. 1. [Imperfect fish ; British Museum.]

1888. *Pholidophorus purbeckensis*, W. Davies, in R. Damon, Geol. Weymouth, ed. 3, Suppl. pl. xix. fig. 1.

Type. Imperfect fish ; British Museum.

A small species, attaining a length of about 0·09. Length of head with opercular apparatus about equal to the maximum depth

P. 1058. Des? & fig! Lov. cit. 1895, p. 32, pl. iv. fig. 5.
P. 4412. Noticed Lov. cit. 1895, p. 30.

P. 1058 a. Des? & fig! Lov. cit. 1895, p. 30, pl. iv. fig. 1.
P. 1058 b. Vertebral rings des? & fig? Lov cit. 1896, p. 31, pl. iv. fig. 2.

P. 4406. Pelvic & caudal fins des? & fig? Lov cit. p. 31, pl. iv. figs. 3, 4.
P. 3704 is noticed by A. S. W., Proc. Bath Nat. Hist. & Antiq. Field Club, vol. viii (1896), p. 242.

ICHTHYOKENTEMA Lowdw. 1941
(Type P. purbeckensis = P. brevis).

1919. Pholidophorus purbeckensis, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 108, pl. xxii. figs. 1–3.
1941. Ichthyokentema purbeckensis = P. brevis A. S. W., a. M. N. H. (11) 8: p. 90.

P.6171. Desc. & figs. A.S.W. 1919, p. 108, pl. xxii. fig. 1.
P.8378. Well-preserved fish, in counterpart, desc. & figs. A.S.W. 1919, p. 108, pl. xxii. fig. 2; L. Purbeck, Isle of Portland. By exchange, 1896.
40635. Postclavicular scales noticed A.S.W. 1919, p. 109.
P.7640. Small fish desc. & figs. A.S.W. 1919, p. 108, pl. xxii. fig. 3; L. Purbeck, Jeffont, Wilts. P. B. Brodie Coll.
P.12347. Imperfect fish, cranial roof noticed A.S.W. 1919, p. 108; M. Purbeck, Swanage. History unknown.
P.8379. Imperfect fish, in counterpart, the vertebrae noticed A.S.W. 1919, p. 109; L. Purbeck, Portland Exchange, 1896.

P.3607 & P.1073 are counterparts.

Pholidophorus brevis, Davies.

1919. Pholidophorus brevis, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 110, pl. xxii. figs. 4, 5.

P.1074. Desc. & figs. A.S.W. 1919, p. 110, pl. xxii. fig. 4.
P.3607. Desc. & figs. A.S.W. 1919, p. 110, pl. xxii. fig. 5.

of the trunk, and nearly one-quarter the total length of the fish. Head and opercular bones feebly rugose. Fulcra remarkably large and stout on all the fins. Pelvic fins arising much in advance of the middle point of the trunk, and the dorsal opposed to the space between these and the anal. Scales large and smooth, the hinder margin not serrated; four longitudinal flank-series deeper than broad, and that of the lateral line unusually deepened.

Form. & Loc. Purbeckian: Dorsetshire.

P. 6171. Type specimen figured in Damon's Geol. Weymouth, ed. 3, Suppl. pl. xix. fig. 1, and scales figured in Geol. Mag. [3] vol. iv. pl. x. fig. 3; Lower Purbeck, Isle of Portland. The dorsal border in advance of the dorsal fin is apparently destroyed and removed. *Damon Coll.*

40635. A much-crushed specimen, in counterpart, imperfectly shown in Geol. Mag. [3] vol. iv. pl. x. fig. 2; Lower Purbeck, Isle of Portland. The large fulcra on the dorsal fin are well shown, and the squamation is much fractured. *Purchased*, 1867.

P. 1074. Fish much shortened and deepened by crushing, as indicated by the displaced dorsal fin; Upper Purbeck, Upway, near Weymouth. This is the type specimen of the so-called *P. brevis* of W. Davies; and acutely-pointed small teeth, sometimes uncinate, are conspicuous in the region of the mouth. *Egerton Coll.*

P. 3607. Imperfect head and abdominal region, noticed *loc. cit.* 1887, p. 339; Upway. *Enniskillen Coll.*

P. 1073. Fragmentary fish; Upway. *Egerton Coll.*

P. 6376. Very imperfect trunk; locality uncertain. *Beckles Coll.*

Pholidophorus higginsi, Egerton.

1854–55. *Pholidophorus higginsi*, Sir P. Egerton, Ann. Mag. Nat. Hist. [2] vol. xiii. p. 435, and Figs. & Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv.), no. 7, p. 1, pl. vii. figs. 1–5.

1854–55. *Pholidophorus nitidus*, Sir P. Egerton, *ibid.* p. 435, and *ibid.* p. 3, pl. vii. figs. 6–8. [Imperfect head and portion of trunk; Bristol Museum.]

1876. *Pholidophorus mottiana*, W. J. Harrison, Quart. Journ. Geol.

Soc. vol. xxxii. p. 215 (name only). [Imperfect fish; Leicester Museum.]

1889. *Pholidophorus nitidus*, A. S. Woodward, Trans. Leicester Lit. & Phil. Soc. n. s., pt. xi. p. 22.

Type. Head and abdominal region, wanting fins; British Museum.

A very small species, apparently not exceeding 0·065 in length. Head with opercular apparatus occupying one-quarter of the total length of the fish; maximum depth of the trunk also equalling one-quarter of the total length, and the caudal pedicle robust. External bones coated with smooth ganoine. Dorsal fin opposed to the pelvic pair, which is situated at the middle point of the trunk. Scales large and smooth, the hinder margin slightly convex, scarcely serrated, but sometimes provided with from one to four slender acuminate denticles; course of lateral line very conspicuous; four longitudinal series of flank-scales much deeper than broad.

In the original definition of this species, Egerton seems to have been misled by the distortion of the type specimen, and thus supposed the relative size of the head and depth of the trunk of the fish to be much greater than now proves to be the case. From an examination of all the known specimens, the present writer is convinced that the above amended definition is a correct expression of the facts.

Form. & Loc. Rhætic: Gloucestershire and Leicestershire.

P. 578. Type specimen, deepened by crushing in the abdominal region, wanting the greater portion of the cranium and caudal region; from the Cotham Marble, Aust Cliff, near Bristol. *Egerton Coll.*

P. 3592. Imperfect fish, with traces of the dorsal and paired fins, but wanting the anal and caudal fins; Cotham Marble, Aust Cliff. *Enniskillen Coll.*

P. 3592 a. Group of remains of four associated large individuals, each wanting the hinder portion of the tail; Cotham Marble, Aust Cliff. *Enniskillen Coll.*

41279. Three portions of trunk and a block of scattered scales; Cotham Marble, Aust Cliff. *Purchased*, 1869.

P. 5932–33. Three specimens, described by the present writer, *loc. cit.* 1889; Paper Shales, Wigston, near Leicester. These fossils comprise the greater portion of the head and trunk with the paired and anal fins; also an imperfect

PHOLIDOPHOROIDES Woodw. 1941.

(Type P. cranulatus).

1941. Pholidophoroides cranulatus A.S.W. 1941, A.M.N.H. (11) 8 p. 89.

1966. P. c. O Nybelin Bull. BMNH Geol 11: 393, pls 8-10, tfs 9-11.

trunk with the dorsal, anal, and part of the caudal fins; and a caudal pedicle with some well-preserved scales and the greater portion of the caudal fin.

Presented by Edward Wilson, Esq., 1889.

The following specimen indicates either an unusually large individual of *Pholidophorus higginsi* or an allied species:—

41281. Portion of abdominal squamation with fragments of the paired fins; Rhætic (Cotham Marble), Aust Cliff, near Bristol. *Purchased*, 1869.

oides
Pholidophorus crenulatus, (Egerton.)

[Plate XII. fig. 6.]

1843. *Pholidophorus crenulatus*, Sir P. Egerton, Proc. Geol. Soc. vol. iv. p. 184.

1852. *Pholidophorus crenulatus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv.), no. 5, pl. v.

1887. *Isopholis crenulatus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 216.

1890. *Pholidophorus crenulatus*, Woodward & Sherborn, Catal. Brit. Foss. Vertebrata, p. 146.

Type. Two imperfect fishes; British Museum.

A species of slender proportions, attaining a length of about 0·15. Length of head with opercular apparatus equalling the maximum depth of the trunk and one-fifth of the total length of the fish. The rugose ornament of the head and opercular bones very feeble or absent; maxilla comparatively robust—this, the dentary, and suborbitals marked with delicate longitudinal striations; angle of the preoperculum with sparse, short, radiating ridges. Pelvic fins arising at a point twice as far from the caudal as from the pectoral extremity of the trunk; dorsal fin opposed to the space between the pelvic and anal fins. Scales of moderate size, the hinder margin coarsely crenulated, the anterior, inferior, and superior borders with a few fine parallel ridges of ganoine corresponding to the lines of growth; flank-scales little deeper than broad.

Form. & Loc. Lower Lias: Dorsetshire.

P. 572–3. The two type specimens, described and figured *loc. cit.* 1852; Lyme Regis. *Egerton Coll.*

P. 1046 a. Fine specimen 0·15 in length, shown of the natural size in Pl. XII. fig. 6; Lyme Regis. Traces of ring-vertebræ (*v.*) occur in the abdominal region. *Egerton Coll.*

41857. Another large imperfect fish, displayed from the ventro-lateral aspect; Lyme Regis. *Purchased*, 1870.

38110. Large distorted specimen, dorsal aspect, showing vertebral rings in the abdominal region; Lyme Regis. The course of the lateral line on the cranial roof in the interorbital region is marked by few transversely elongated bosses. *Purchased*, 1864.

P. 421. Specimen 0·12 in length, showing the fulcra on the median fins; Lyme Regis. *Presented by F. Seymour Haden, Esq.*, 1882.

P. 1046 b. Equally large fish wanting the dorsal fin and the upper lobe of the caudal fin; Lyme Regis. *Egerton Coll.*

38534, 38730, 38738. Three fishes about 0·115 in length, the first much broken in the region of the head; Lyme Regis. In the first specimen the fulcra of the right pectoral fin are conspicuous and have the appearance of being firmly united. *Purchased*, 1864–65.

47461, 47466. Two equally large fishes, somewhat imperfect and distorted; Lyme Regis. *Purchased*, 1876.

48008–10. Two small fishes 0·092 and 0·105 in length respectively, and a larger distorted fish, ventro-lateral aspect; Lyme Regis. *Purchased*, 1877.

P. 3595, P. 4415–16. Four typical specimens, from 0·09 to 0·125 in length; Lyme Regis. *Enniskillen Coll.*

36313. A much-abraded imperfect large specimen, wanting the median fins, probably of this species; Lyme Regis. *Presented by Miss Wilson*, 1862.

Pholidophorus limbatus, Agassiz.

[Plate XII. fig. 7.]

1833–44. *Pholidophorus limbatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. pp. 9, 282, pl. xxxvii. figs. 1–5.

Type. Distorted specimens of trunk.

A species of moderate size, attaining a length of about 0·18–0·2. Length of head with opercular apparatus almost as great as the maximum depth of the trunk, and contained four-and-a-half times in the total length of the fish. The rugose ornament of the head and opercular bones very feeble or absent; maxilla comparatively

1852. P. L. Blainv. Hdb. Malac. p. 237 pl. 37 f. 4a.
1966 Photidophoroides limbata (Ag.) O Nybelin,
Bull. BMNH Geol. II 1404, pls 11, 12, fig. 12.

robust, and its longitudinal striations delicate; angle of the preoperculum with few short, radiating ridges. Pelvic fins arising far in advance of the middle point of the trunk, and the dorsal fin opposed to the space between the pelvic and anal fins. Scales large and smooth, the hinder margin strongly though finely serrated, and the sharp points passing into conspicuous crenulations when the surface is partly abraded; five longitudinal flank-series deeper than broad.

Form. & Loc. Lower Lias: Dorsetshire.

P. 1047. Nearly complete fish 0·18 in length, shown of the natural size in Pl. XII. fig. 7; Lyme Regis. The maxilla and two supramaxillaries are well shown, and all the opercular elements are distinguishable, with some branchiostegal rays below. The small pectoral fins are nearly complete, and exhibit very delicate, slender fulcra; and remains of the pelvic, anal, and dorsal fins indicate their precise relative positions. The caudal fin is complete, and both this and the dorsal are conspicuously fulcrated. The squamation is well preserved, and attention may be called to the large ridge-scale on the upper border of the caudal pedicle. *Egerton Coll.*

P. 3596. Large fish displayed from the ventro-lateral aspect, wanting the greater portion of the head and caudal fin, and the dorsal part of the trunk; Lyme Regis. Minute fulcra are distinctly shown on the pelvic fins, and somewhat larger fulcra on the anal fin. One enlarged median ventral scale and a pair of smaller scales behind evidently denote the position of the anus immediately in front of the anal fin. *Enniskillen Coll.*

36472. A smaller specimen, much broken but wanting only the pelvic fins; Lyme Regis. *Purchased*, 1862.

38531–32. Fish about 0·16 in length, wanting the anterior half of the head, and another distorted specimen; Lyme Regis. The operculum, suboperculum, and preoperculum (this with short radiating ridges) are well shown in the first specimen; a clavicle is displayed in both.

Purchased, 1864.

41906. Imperfectly preserved fish 0·145 in length; Lyme Regis.

Purchased, 1870.

P. 1047 a, b, c. Two imperfect specimens of moderate size, and the well-preserved caudal half of another fish; Lyme Regis.
Egerton Coll.

P. 3632, P. 4410. Imperfect trunk with well-preserved squamation, and remains of a small fish; Lyme Regis.
Enniskillen Coll.

48041. Hinder portion of head and the greater part of the abdominal region, with pectoral fins; Lyme Regis.
John Brown Coll.

P. 7582. Imperfect skeleton probably of this species; Lyme Regis. The very delicate ring-vertebræ are shown, and the comparatively small ridge-scale on the caudal pedicle. Fulcra are seen on the paired fins, and one pelvic basipterygium is preserved. *History unknown.*

Pholidophorus hartmanni, Egerton.

[Plate XII. figs. 4, 5.]

1843. *Pholidophorus hartmanni*, Sir P. Egerton, Proc. Geol. Soc. vol. iv. p. 184.

Type. Small distorted fish; British Museum.

A species of moderate size, attaining a length of about 0·17. Length of head with opercular apparatus greater than the maximum depth of the trunk, and occupying more than one-quarter of the total length of the fish. The rugose ornament of the head and opercular bones very feeble or absent; maxilla comparatively robust, ornamented with delicate, longitudinally directed rugæ; preoperculum with few short, radiating ridges. Pelvic fins arising far in advance of the middle point of the trunk, and opposed to the dorsal fin. Scales of moderate size, smooth, the hinder margin strongly though finely serrated, and the sharp points passing into conspicuous crenulations when the surface is partly abraded; about six longitudinal flank-series deeper than broad; lateral line forming a feeble ridge.

Form. & Loc. Upper Lias: Würtemberg. ? Gaude Franc.

P. 605. The type specimen, a small fish distorted anteriorly, wanting the head, and shown of the natural size in Pl. XII. fig. 4; Ohmden. Of the fins only parts of the dorsal and caudal remain; but the characters of the squamation are well displayed. *Egerton Coll.*

P. 1047 b. Fulcra of anal fin fig. A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), pl. xxii. fig. 6.

1935. Pholidophorus aff. hartmanni, Cranbourne, p. 11, tf. 6-7, pl. i/pl. ii. f. 1.

P. 3591. Two specimens about 0·095 in length, with imperfect head and squamation, but showing parts of all the fins; Ohmden. *Enniskillen Coll.*

22520, 22527. Fish about 0·12 in length, in counterpart, wanting the greater part of the head and deepened by distortion in the anterior abdominal region; Boll. *Purchased*, 1848.

19653. Abraded remains of a large fish 0·155 in length; Boll. *Purchased*, 1845.

19653 a. Remains of head and trunk of a similar fish, much disturbed and abraded; Boll. The jaws and opercular bones are shown of the natural size in Pl. XII. fig. 5. *Purchased*, 1845.

22533. Another large imperfect specimen; Boll. *Purchased*, 1848.

P. 3591 a. Portion of small trunk; Ohmden. *Enniskillen Coll.*

Pholidophorus macrocephalus, Agassiz.

1834–44. *Pholidophorus macrocephalus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 274, pl. xl.

1843–44. *Pholidophorus striolaris*, L. Agassiz (*ex* Münster, MS.), *ibid.* p. 277, pl. xxxviii. fig. 4. [Imperfect small fish; Palæontological Museum, Munich.]

1839–44. *Pholidophorus latus*, L. Agassiz, *ibid.* p. 278, pl. xli. [Imperfect fish; Palæontological Museum, Munich.]

1844. *Pholidophorus taxis*, L. Agassiz, *ibid.* p. 287.

1844. *Pholidophorus radians*, L. Agassiz, *ibid.* p. 287.

1844. *Pholidophorus uraeoides*, L. Agassiz, *ibid.* p. 287.

1842. *Caturus intermedius*, G. von Münster, Neues Jahrb. p. 44. [Imperfect fish; Palæontological Museum, Munich.]

1848. *Pholidophorus macrocephalus*, C. G. Giebel, Fauna der Vorwelt, Fische, p. 205.

1848. *Pholidophorus radians, uraeoides, striolaris, taxis, latus*, C. G. Giebel, *ibid.* pp. 205, 207.

1852. *Pholidophorus latus* = *P. macrocephalus*, F. A. Quenstedt, Handb. Petrefakt. p. 208.

1858. *Pholidophorus latus*, F. A. Quenstedt, Der Jura, p. 810, pl. c. fig. 11.

1863. *Pholidophorus macrocephalus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 660.

1863. *Pholidophorus striolaris* = immature *P. macrocephalus*, A. Wagner, *ibid.* p. 661.

1863. *Pholidophorus radians*, A. Wagner, *ibid.* p. 662.

1881. *Pholidophorus magnus*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. p. 63. [A new collective name given to the species to which the above synonymy applies.]

1887. *Pholidophorus striolaris*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 214, figs. 226, 227.

Type. Imperfect fish with scattered squamation; Palæontological Museum, Munich.

A large robust species, attaining a length of about 0·4. Length of head with opercular apparatus somewhat less than the maximum depth of the trunk, which equals about one-quarter of the total length of the fish. Head and opercular bones very finely rugose; maxilla very conspicuously ornamented, the rugæ chiefly longitudinal and in part reticulated; angle of preoperculum with feeble radiating ridges; teeth comparatively robust, obtusely pointed. Fin-rays very stout, smooth or delicately rugose; fulcra conspicuous. Pelvic fins arising far in advance of the middle point of the trunk, and the dorsal fin opposed to them. Scales large, ornamented with fine oblique striations, more or less radiating, and terminating at the hinder margin in prominent denticulations; several series of flank-scales deeper than broad; the orifices of the lateral line inconspicuous, and the ornament on the caudal region becoming feeble.

The synonymy of this species is given in accordance with the researches of Wagner and Vetter. Very probably there must also be added to it the name of *Pholidophorus microps*, given to a small fish from Solenhofen in the Palæontological Museum, Munich (L. Agassiz, Poiss. Foss. vol. ii. pt. i. 1833–44, pp. 9, 275, pl. xxxviii. fig. 1; A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 666; B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. 1881, pp. 60, 70).

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 5542. Fine specimen, about 0·39 in length, perhaps a little elongated by distortion; Eichstädt. Part of the axial skeleton of the trunk is displayed and coprolitic matter indicates the remote situation of the anus.

By exchange, 1888.

37082. Fragmentary distorted large fish, displaying the caudal fin, and showing the absence of completed ring-vertebræ; Solenhofen. *Häberlein Coll.*

36004–5. Scattered remains of a large fish, in counterpart, showing branching of sensory canal on lower suborbital plate, also comprising the enlarged ridge-scale on the caudal pedicle; Solenhofen. *Häberlein Coll.*

1906. Pholid. macrocephalus, E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 176, pl. xxix. figs. 2, 4, 8, 9.

1914. Pholidophorus macrocephalus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 421, pl. lviii. fig. 1.

1927. Ph. macrocephalus, W. Biese, Neues Jahrb. vol. LVIII, Beil. Bd., Abt. B., p. 51, t-fgs. 1-10, pl. viii.

1927. Ph. striolatus, W. Biese ibid. p. 65, t-fgs. 11-12 [considered to be distinct sp.]. (In part P. similis acc. S. Stensiö 1948 p. 57.)

1906. Pholid. microps, E. Heinecke, loc. cit. p. 179.

P.1070 b seems to show toothless splenial.

P. 1070—a. Scattered remains of two other large specimens; Solenhofen. Many of the scales are well shown, and a dentigerous bone in the first specimen exhibits some of the minute teeth; a few stout dorsal and pelvic fin-rays also occur. *Egerton Coll.*

P. 1066, P. 3582. Large head, in counterpart, probably of this species; Solenhofen. The preoperculum does not exhibit radiating ridges. *Egerton & Enniskillen Colls.*

P. 3584. Imperfect trunk of a large fish, displaying the caudal fin; Solenhofen. *Enniskillen Coll.*

P. 3647. Remains of a large fish; Solenhofen. *Enniskillen Coll.*

P. 3581. Greater part of the trunk of another large fish, with well-preserved squamation; Eichstädt. The stout dorsal fin-rays are feebly rugose. *Enniskillen Coll.*

P. 1070 b. Mandibular ramus, pelvic bone, fin-rays, and scattered scales of a large fish; Solenhofen. *Egerton Coll.*

22508. Imperfect contorted specimen about 0·21 in length; Solenhofen. *Purchased*, 1848.

37073, 37091, 37805–07. Five specimens from 0·2 to 0·22 in length, three being in counterpart and exhibiting all the principal characters of the species; Solenhofen. *Häberlein Coll.*

37033, 37037. Two imperfect fishes; Solenhofen. *Häberlein Coll.*

P. 1070. Fragmentary specimen; Solenhofen. *Egerton Coll.*

P. 1067. Remains of head and squamation, moderate size; Eichstädt. *Egerton Coll.*

P. 1067 a, b, P. 1084. A similar specimen and portions of two smaller fishes; Solenhofen. *Egerton Coll.*

P. 1085. Scattered remains of small head and squamation; Moritzbrunn, near Eichstädt. *Egerton Coll.*

P. 3603. Imperfect portion of head and abdominal region, of small size; Eichstädt. *Enniskillen Coll.*

P. 3582 a, P. 3603 a, b. Scattered remains of two small fishes and part of the caudal squamation of a third specimen; Solenhofen. *Enniskillen Coll.*

P. 1068. Scattered remains of a small fish, probably of this species, labelled "*Pholidophorus latus*, Agass.," by Agassiz; Solenhofen. *Egerton Coll.*

Pholidophorus similis, sp. nov.

[Plate XIII. fig. 2.]

Type. Nearly complete fish; British Museum.

A species of moderate size. Length of head with opercular apparatus nearly equalling the maximum depth of the trunk, which is contained from four-and-a-half to five times in the total length of the fish. Head and opercular bones very finely rugose. Fin-rays stout and smooth. Pelvic fins arising far in advance of the middle point of the trunk, and the dorsal fin opposed to them. Scales large, ornamented with fine oblique striations, more or less radiating, and terminating at the hinder margin in denticulations; several series of flank-scales deeper than broad; the orifices of the lateral line inconspicuous.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 1083. Type specimen, wanting the anterior half of the head, shown of the natural size in Pl. XIII. fig. 2; Cirin. The squamation and caudal fin are well shown, and portions of all the other fins occur, the dorsal being evidently displaced a little forwards. The large ridge-scale on the upper border of the caudal pedicle is especially prominent. *Egerton Coll.*

Pholidophorus granulatus, Egerton.

1854. *Pholidophorus granulatus,* Sir P. Egerton, Ann. Mag. Nat. Hist. [2] vol. xiii. p. 434.

1855. *Pholidophorus granulatus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv.), no. 4, pl. iv. figs. 1, 2.

Type. Fish wanting caudal fin: Dorset County Museum, Dorchester.

A large robust species, attaining a length of about 0·3. Maximum depth of trunk equalling about one-third of the total length of the fish. Head and opercular bones finely tuberculated or rugose, the tuberculations extending upon the dorsal scales of the abdominal region. Fin-rays smooth and stout; fulcra conspicuous. Pelvic fins arising far in advance of the middle point of the trunk, and the dorsal fin opposed to them. Scales large, ornamented with very

1914. *Pholidophorus similis*, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 381, pl. lvi. fig. 1.

1949. P. S. P. ab Sauvage-Sercla N. Arch. Mus. H.N. Lyon 2 p. ~~235~~ 215 figs. 93, 94 pl. xxii.

1919. *Pholidophorus granulatus*, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 106, pl. xxi. figs. 5, 6.

P.3605. Des? d fig? A.S.W. 1919, p. 106, pl. xxi. fig. 6.

P.6379. Des? d fig? A.S.W., 1919, p. 106, pl. xxi. fig. 5.

1949. P.O. P. de S? Sorio, N. Arch. Mus. N.H. Lyon 2 p. 221.

Pholidophoristion Woodw. 1941.
(Type P. ornatus).

1918. Pholidophorus ornatus, A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916), p. 102, pl. xx, figs. 5–8; pl. xxi. fig. 4; text-fig. 34.
1941. Pholidophoristion ornatus A.S.W., A. Mus. N.H. (11) 8. p. 90

fine oblique ridges, slightly radiating and terminating at the hinder margin in delicate serrations; several series of flank-scales deeper than broad; lateral line inconspicuous.

Form. & Loc. Purbeckian: Dorsetshire.

P. 3605. Roof of cranium and greater portion of trunk, displaying squamation; Swanage. *Enniskillen Coll.*

P. 6379. Imperfect large head and trunk; Swanage. Much of the squamation is well displayed, while the left operculum and suboperculum are shown from within. As in the preceding specimen, some of the ribs and neural arches of the abdominal region are exhibited, without any trace of vertebral rings. *Beckles Coll.*

P. 6378 a. Portion of a small individual, with some well-preserved scales; Swanage. *Beckles Coll.*

Pholidophorus ovatus, Wagner.

1863. *Pholidophorus ovatus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 666.

Type. Fish with imperfect median fins; Palæontological Museum, Munich.

A robust species attaining a length of about 0·16, not yet clearly distinguished from *P. granulatus*, but perhaps with a somewhat less deepened trunk. Fins and scales as in the last species.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria[1].

P. 1080. Well-preserved trunk with squamation displayed from the inner aspect; Kelheim. All the fins are shown, except the pectorals, of which only the distal extremity remains. *Egerton Coll.*

Pholidophorus ornatus, (Agassiz.)

1843–44. *Pholidophorus ornatus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 280, pl. xxxvii. figs. 6, 7.

1855. *Pholidophorus ornatus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv.), no. 4, p. 1, pl. iv. fig. 3.

Type. Caudal region of fish; British Museum.

A robust species, attaining a length of about 0·2. Head with opercular apparatus occupying much less than one-quarter of the total length of the fish, and the maximum depth of the trunk equalling

[1] Also recorded from Cirin, Ain, France, by A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. 1860, p. 402.

one-quarter of the same total length. All the head and opercular bones smooth or very feebly rugose in part; angle of preoperculum with indications of radiating ridges; maxilla not much arched; teeth comparatively robust, obtusely pointed. Fin-rays smooth and stout; fulcra conspicuous. Pelvic fins arising far in advance of the middle point of the trunk, and the dorsal fin opposed to them. Scales large, ornamented with coarse oblique ridges, slightly radiating, and terminating at the hinder margin in very prominent denticulations; several series of flank-scales deeper than broad; the orifices of the lateral line prominent, forming a ridge on the caudal pedicle; the ornament on the caudal region becoming feeble.

Form. & Loc. Purbeckian: Dorsetshire.

P. 7583. Imperfect caudal region, the type specimen described and figured by Agassiz, *loc. cit.*; Swanage. Agassiz' determination of the dorsal is shown by Egerton (*loc. cit.*) to be due to a misinterpretation of some broken scales and inaccurate drawing. The enlarged scale at the base of the upper caudal lobe is pointed at each extremity and very feebly rugose. *Mantell Coll.*

43038. Greater portion of fish, much crushed and distorted; Swanage. *Purchased*, 1871.

P. 6378. Another fine specimen, somewhat distorted, the chief basis for the proportions of the fish given in the above diagnosis; Swanage. *Beckles Coll.*

28445–46. Two more imperfect specimens, displaying parts of the head-bones and squamation; Swanage. *Cunnington Coll.*

P. 4411. Remains of head with well-preserved abdominal flank-scales, and part of the axial skeleton of the caudal region; Swanage. The neural and hæmal arches in the caudal region are short, robust, and much inclined backwards, and the vertebræ are delicate broad rings, possibly divided into hypocentral and pleurocentral pieces. *Enniskillen Coll.*

P. 3605 a. Head and abdominal region, ventral and partly lateral aspect; Swanage. The nearly smooth maxillæ and dentaries, with their regular series of obtusely pointed teeth, are well shown; and fulcra are conspicuous both on the pectoral and pelvic fins. *Enniskillen Coll.*

P. 1075. Crushed portion of caudal region; Upway, near Weymouth. *Egerton Coll.*

P.7583. Des.d & fig.d A.S.W. 1918, p. 102, pl. xx. fig. 5.
Saw the finest known specimen of this fish in the collection of Mr. Alexander J. Hogg, Aug. 14th. 1897. A.S.W. Pres.d by him July 19th. 1904. A.S.W.

↓

P.10011. Nearly complete small fish, described and figured by A.S.W. loc. cit. 1918, p. 102, pl. xx. fig. 6. Pres.d by Alexander J. Hogg, Esq., 1904.

43038. Scales des.d & fig.d A.S.W. 1918, p. 105, pl. xx. fig. 7. Ribs noticed, p. 104.

28445. Parasphenoid teeth noticed A.S.W. 1918, p. 103.
28446. Slime canal on frontals & entopterygoid teeth noticed A.S.W. 1918, p. 103.

P.3605a. Vertebrae noticed, A.S.W. 1918, p. 104.

1927. *Ph. microonyx*, W. Biese, Neues Jahrb., Beil. Bd, Abt. B. p. 69, t. f. 13.

1941. *Pholidophoristion microonyx* A.S.W. A.M.N.H. (11) 8, 9

Pholidophorus micronyx, (Agassiz.)

[Plate XIII. fig. 3.]

1838–44. *Pholidophorus micronyx*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 279, pl. xlii. fig. 1.

1838–44. *Pholidophorus intermedius*, L. Agassiz (*ex* Münster, MS.), *ibid.* p. 279, pl. xlii. fig. 3. [Imperfect small fish; Palæontological Museum, Munich.]

(?) 1861. *Caturus brevis*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 63, fig. 11. [Imperfect fish; Teyler Museum, Haarlem.]

1863. *Pholidophorus micronyx*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 666.

1881. *Pholidophorus micronyx*, B. Vetter, Mittheil. k. mineral.-geol. Mus. Dresden, pt. iv. pp. 62, 110.

1887. *Pholidophorus micronyx*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 215, fig. 228.

Type. Imperfect fish; Palæontological Museum, Munich, and Woodwardian Museum, Cambridge.

A species as yet imperfectly distinguished from *P. ornatus*, apparently only differing from the latter in its smaller size and somewhat more slender form of the trunk.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 1071. Fish about 0·115 in length, imperfect anteriorly and wanting the greater part of the dorsal and anal fins; Kelheim. The maxilla is not much arched, while both this, the facial and opercular bones are nearly smooth. The anterior pelvic fin-rays are broad and flattened, with a fringe of conspicuous fulcra (shown of three times the natural size in Pl. XIII. fig. 3 *b*). About five rows of scales on the flank are deeper than broad, and some of those at the beginning of the caudal region are shown of three times the natural size in Pl. XIII. fig. 3 *a*. In the hinder half of the caudal region the lateral line forms a very prominent ridge. The enlarged scale at the base of the upper caudal lobe is pointed in front, obtuse behind, and finely ornamented with striæ of ganoine radiating from the longitudinal middle line. *Egerton Coll.*

P. 1078, P. 3600. More imperfect specimen, in counterpart, showing inner face of squamation, and separate pleurocentra and hypocentra in the axial skeleton, also delicate short ribs; Kelheim. *Egerton & Enniskillen Colls.*

37101. Imperfect fish about 0·15 in length, displaying scale-ornament; Solenhofen. *Häberlein Coll.*

P. 3601. Smaller imperfect fish, probably of this species; Kelheim. *Enniskillen Coll.*

Pholidophorus (?) gregarius, A. S. Woodward.

1890. *Pholidophorus gregarius,* A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 44, pl. vi. figs. 6–10.

Type. Imperfect fish; Museum of Geol. Surv. N. S. Wales, Sydney.

A small species attaining a length of about 0·05. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and occupying one-fifth of the total length of the fish. External bones feebly rugose. Pelvic fins arising slightly nearer to the anal than to the pectorals; dorsal fin with 12 rays, arising considerably behind the pelvic pair; anal fin smaller, with 8 rays, its origin opposite the middle of the dorsal; caudal fin with only 14 rays. Scales large and smooth, not serrated; four longitudinal flank-series much deeper than broad; two or three enlarged oval ridge-scales at the origin of the median fins; lateral line forming a conspicuous ridge.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6279. Imperfect fish; Gosford. *By exchange,* 1890.

Pholidophorus (?) dubius, A. S. Woodward.

1890. *Peltopleurus* (?) *dubius,* A. S. Woodward, Mem. Geol. Surv. N. S. Wales, Palæont. no. 4, p. 47, pl. vi. figs. 4, 5.

Type. Imperfect fish; Museum of Geol. Surv. N. S. Wales, Sydney.

A very stout small species, about 0·06 in length. Length of head with opercular apparatus contained about four-and-a-half times, and maximum depth of trunk three times in the total length of the fish. Pelvic fins somewhat nearer to the anal than to the pectorals; dorsal fin with about 11 rays, arising just in advance of the anal, which is slightly smaller; caudal fin with at least 16 rays. Scales large and smooth, possibly with fine serrations.

Form. & Loc. Lower Hawkesbury-Wianamatta Series (Upper Trias): Gosford, New South Wales.

P. 6278. Crushed specimen; Gosford. *By exchange,* 1890.

P. 6274. Another imperfect specimen associated with *Pristisomus latus*; Gosford. *By exchange,* 1890.

Perleididae.

Chrotichthys, g.n. Wade 1940.

1940. Chrotichthys gregarius, R.T. Wade, J. Proc. R. Soc. N.S.W. 73, 210, 1 f. 2, pl. xi. f. 2.

Perleididae.

Tripelta, g.n. Wade 1940.

1940. Tripelta alubria, R.T. Wade, J. Proc. R. Soc. N.S.W. 73, 208, 1 f. 1, pl. xi. f. 1.

P.4265. Tail fig? A.S.W., Proc. Dorset Nat. Field Club, vol. xviii (1897), p. 152, plate fig. 2.
An imperfect fish from the Oxford Clay of Chickerell, near Weymouth (Nelson Richardson Coll.) is desd & figd by A.S.W. Loc. cit. 1897, p. 150, plate fig. 1.

The following specimens of *Pholidophorus* are too imperfect for specific determination :—

P. 5992. Imperfect fish wanting the greater part of the fins, originally about 0·05 in length; Upper Trias, Lunz, Lower Austrian Alps. *Purchased*, 1889.

32451. Small imperfect trunk, with strongly pectinated abdominal flank-scales; Upper Lias, Caen, Normandy. *Tesson Coll.*

P. 4419. Imperfect fish about 0·12 in length, with serrated scales and those of flank much deepened; Upper Lias, Ohmden, Würtemberg. *Enniskillen Coll.*

P. 3597. Cranial roof described and figured as the type specimen of *Pholidophorus minor* by L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1843–44), p. 286, pl. xlii. *a*. fig. 5; Bathonian (Stonesfield Slate), Stonesfield, Oxfordshire. *Enniskillen Coll.*

P. 1072. Similar cranial roof and a detached scale; Stonesfield Slate. *Egerton Coll.*

26471. Large specimen, ventral aspect, closely resembling *Pholidophorus macrocephalus*; Oxford Clay, Christian Malford, Wiltshire. *Purchased*, 1851.

26471 a. Remains of head and anterior squamation of similar fish; Christian Malford. *Purchased*, 1851.

P. 4265, P. 4634. Scattered remains of similar fish, and a smaller specimen; Christian Malford. *Enniskillen Coll.*

32579. Imperfect head, pectoral fins, and anterior scales; Oxford Clay, Dives, Normandy. *Tesson Coll.*

P. 3686. Imperfect head and anterior scales of a large species resembling *P. macrocephalus*; Kimmeridge Clay, Kimmeridge, Dorsetshire. Not less than 18 pairs of branchiostegal rays are seen between the mandibular rami. *Enniskillen Coll.*

P. 4687. Imperfect fish, chiefly shown in impression; Lithographic Stone, Cirin, Ain, France. *Purchased*, 1884.

The following specimens are doubtfully determined, but present no characters by which they can be distinguished from *Pholidophorus* :—

P. 603. Type specimen of the so-called *Semionotus minutus* (Egerton, Proc. Geol. Soc. vol. iv. 1843, p. 183); Upper Trias,

Giffoni, Province of Salerno, Italy. This is the caudal half of a fish as small as *P. pusillus*, but apparently with less-deepened scales and stouter caudal pedicle. The dorsal fin is entirely in advance of the anal. *Egerton Coll.*

P. 566. Type specimen of the so-called genus and species *Nothosomus octostychius* (Agassiz, Poiss. Foss. vol. ii. pt. i. 1844, p. 292, name only), described by Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv. 1858), no. 6, pl. vi.; Lower Lias, Street, Somersetshire. This appears to be a deep-bodied species of *Pholidophorus* with unusually thick scales, but its systematic position cannot be determined until the discovery of the head. *Egerton Coll.*

The following species, for the most part referable to *Pholidophorus*, are founded on imperfect specimens and do not appear to be represented in the Collection :—

Pholidophorus aalensis, F. A. Quenstedt, Der Jura (1858), p. 349, pl. xlvii. fig. 37.—Lower Oolite (Braun Jura β); Aalen, Würtemberg. [Impression of part of head and squamation; Tübingen University Museum.]

Pholidophorus angustus, L. Agassiz (*non* Münster), Poiss. Foss. vol. ii. pt. i. (1844), p. 285, pl. xlii. *a*. fig. 2.—Jurassic; Poland. [Pusch Collection.]

Pholidophorus barazzettii, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. (1886), p. 35.—Keuper; Besano, Lombardy. [Milan Museum.]

Pholidophorus beggiatianus, A. de Zigno, Atti Istit. Veneto Sci. [3] vol. xi. (1866), p. 963, pl. ii.—Jurassic; Rotzo, Sette Comuni, Prov. Vicenza, Italy.

Pholidophorus besanensis, F. Bassani, *loc. cit.* (1886), p. 36.—Keuper; Besano. [Milan Museum.]

Pholidophorus bronni, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. (1866), p. 185, pl. v. fig. 1.—Upper Trias; Raibl, Carinthia. [Museum of Imperial Geological Survey, Vienna.]

Pholidophorus cornueli, F. J. Pictet, Mém. Soc. Linn. Normandie, vol. xvi. (1872), no. 1, p. 16, pl. i. figs. 1–3.—Portlandian; Haute Marne.

Pholidophorus deeckei, A. de Zigno, Mem. R. Accad. Lincei, [4] vol. vii. (1891), p. 57, pl. ii. figs. 5, 6.—Upper Keuper; Lumezzane, Lombardy. [University Museum, Padua.]

Pholidophorus falcifer, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1863), p. 662.—Lower Kimme-

P. argentinus sp. n. M. Doering & P. de Saez 1939.
– Notas. mus. La Plata 4 p. 430 ff. 4. U Juan. Argentina
[Jail. La Plata].

Ph. anomalus, diagonalis & sculptus n. spp.
Lithogr. St. Barana. W. Biese, Neues Jahrb. LVIII
1927. Beil. Bd. Abt. B. [pp. 74 & f. 17-20) [78 & f. 21-25] [71, 14-16)
respectively. Fragments of Iguan: ett: G.P. Inst. Berlin.

Pholidophorus americanus, C.R. Eastman, Bull. Geol.
Soc. America, vol. x (1899), p. 398, pls. xlv-xlvii. – Jurassic;
Black Hills, S. Dakota. also E. of Santa Rosa, N. Mexico, H.E. Kaerney
1930, Am. J. Sci. (5) xix. p. 463.

Pholidophorus australis, A.S. Woodward, Mem. Geol.
Surv. N.S. Wales, Palaeont. no. 10 (1908), p. 26, pl. iv.
fig. 9. – Hawkesbury Beds; St. Peters, Sydney.
[Imperfect fish; Australian Mus., Sydney.]

Pholidophorus browni, R. Broom, Ann. S. Afr. Mus. vol.
vii. (1909), p. 267, pl. xiii. fig. 10. – Upper Karoo; = Meidlichthys
[Imperfect fish;]
sp. 57.

Pholidophorus bertrandi, F. Priem, Bull. Soc. Géol.
France [4] vol. xii (1912), p. 250, pl. viii, figs. 1, 2. —
Rhaetic; Ariège, France. O. Rybar, Bull. Bohem. Geol. II: 376, pl. 6, fig. 5.

Pholidophorus Caffii, C. Airaghi, Rend. R. Istit.
Lombard Sci. Lett. [2] vol. xli (1908), p. , figs. —
See also F. Bassani,
See Rhaetic; Lombardy.
Pholidophorus overleaf.
Rend. R. Accad. Lincei, Class. Sci. [5] vol. xxiii (1914), p. 376
383 [? probably latiusculus"]; G. De Alessandri, Mem. Soc. Ital.
Sci. Nat. vol. lix (1920), p. 97.

Pholidophorus faccii, M. Gortani, Riv. Ital. Paleont. vol. xiii
(1907), p. 118, pl. ii. – Kenya (Raibl); Cazzaso,

Pholidophorus cornetzi, M. Leriche, Ann. Mus. Congo
Belge.
Rev. Zool. Africaine, vol. i (1911), p. 195, pl. x. fig. 1. –
Jurassic; Kindu, Congo. [Portion of squamation;
Congo Museum, Tervueren.]

Pholidophorus curionii, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 127, pl. viii. figs. 5, 8.
Paleoniscus curioni, J. J. Heckel,

Paraphstidophorus g.n. nybelini sp.n., R. Zambelli, 1975, Rend. Ist. Lombardo. Accad. Sci. Lett., B 109: 3-49 V. Nrian, Cene, Bergamo, Lombardy. Genus includes P. caffi Airaghi

P. sequsianes s.n. P. de Saint-Seine, 1949, N. Arch. mus. H. N. Lyon 2 p. 222 ff. 95-97, pl. xxiii f. A, B. Both: Lyons N.H.M. U. Jur. Cerin.

Hengnania g.n. gracilis sp.n, N-C. Wang, 1977, Vertebrata Palasiatica 15: 177, figs 1-3, pl. 1. L. Jurassic, Hunan, China.

Pholidophorus retchkini, s.n. Gorizdro-Kulczyca 1926; p. 190, t.f. 5. ? Jurassic: Turkestan.

Pholidophorus meridensis, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 134, pl. ix. fig. 12. — Kemper; Besano, Lombardy. [Mus. Civ. Milan.]
Pholidophorus obesus, R. H. Traquair, Poiss. Weald. Berniszark (Mém. Mus. Roy. Hist. Nat. Belg. vol. v. 1911), p. 43, pl. ix. figs. 4-6. — Wealden; Berniszark, Belgium. [Imperfect first; Roy. Mus. Nat. Hist. Brussels.]
Pholidophorus kungi, indicus, spp. nov., P. Vadasjini + K N Prasad, 1977, Jl. Geol. Soc. India, 18: 436-44, Kota Fm (L. Jurassic) Andhra Pradesh

Caturus retrodorsalis = Pholidophorus, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. xi (1898), p. 194.

ridgian (Lithographic Stone); Kelheim. [Palæontological Museum, Munich.]

Pholidophorus furcatus, L. Agassiz, Poiss. Foss. vol. ii. pt. i. (1844), p. 286, pl. xxxvi. fig. 1. *Microps furcatus*, L. Agassiz, *ibid.* (1833), p. 10.—Upper Trias; Seefeld, Tyrol[1]. [Type species of *Microps*; collection of Geological Society of France.]

Pholidophorus gaudryi, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. v. (1892), p. 398, pl. xvii. (reprinted in Bull. Soc. Sci. Yonne, vol. xlvii. 1893, p. 32, pl. ii.).—Upper Lias; Yonne, France. C. Gambong, 1935, p. 23, pl. iii. f. 2. ; S. Cadrin S. E. Lias. Normandie B. 8. 9. 3 n/p. 18

Pholidophorus helveticus, O. Heer, Urwelt d. Schweiz (1865), p. 79 (fig. in French ed., 1872, p. 96).—Lias; Schambelen, Canton Aargau. [Zürich Museum.] Abb. 2

Pholidophorus kneri, A. de Zigno, Mem. R. Accad. Lincei, [4] vol. vii. (1891), p. 57, pl. ii. figs. 3, 4.—Upper Keuper; Lumezzane, Lombardy. [University Museum, Padua.]

Pholidophorus lacertoides, O. Heer, *op. cit.* French ed. (1872), p. 96, fig. 54 B.—Lias; Schambelen.

Pholidophorus maacki, J. V. Rohon, Mém. Acad. Imp. Sci. St. Pétersbourg, [7] vol. xxxviii. no. 1 (1890), p. 10, pl. i. figs. 7, 10.—Jurassic; Ust-Balei, Government of Irkutsk, Siberia. [Fish wanting caudal region; Imperial Academy of Sciences, St. Petersburg.]

Pholidophorus muensteri, C. G. Giebel, Fauna d. Vorw., Fische (1848), p. 208. *Pholidophorus angustus*, G. von Münster (*non* Agassiz), Neues Jahrb. 1842, p. 43.—Lower Kimmeridgian (Lithographic Stone); Kelheim. [Palæontological Museum, Munich.] (? *Eugnathus*.)

as Eugnathus münsteri in Heinecke, 1906, Geol. Paläont. Abh. 12: 181

Pholidophorus oblongus, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia (1857), p. 428; W. Deecke, Palæontogr. vol. xxxv. (1889), p. 124.—Muschelkalk; Perledo, Como. [Milan Museum.] G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 129, pl. viii. figs. 9, 10.

G. D'Erasmo, 1927, Studi Trentini, viii, 200, Pl. i. f. 9.

Pholidophorus (?) *obsoletus*, O. G. Costa, Ittiol. Foss. Ital. (1873), p. 66, pl. v. fig. 8.—Ibid. [Geological Museum, University of Naples.]

Pholidophorus renggeri, O. Heer, *op. cit.* (1865), pp. 78, 79, fig. 50.—Lias; Schambelen. [~~Basle~~ Zürich Museum.] Abb. 2

Pholidophorus retrodorsalis: *Caturus retrodorsalis*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. iv. (1891), p. 79, pl. ix.—Upper Lias; Yonne, France.

[1] A fragmentary fish from Seefeld in the Egerton Collection (P. 1062) may possibly represent this imperfectly determined species.

Pholidophorus roemeri, K. Martin, Zeitschr. deutsch. geol. Ges. vol. xxvi. (1874), p. 816, pl. xxix. figs. 1, 2.—Rhætic; Hildesheim, Hanover.

Pholidophorus taramellii, A. de Zigno, *loc. cit.* (1891), p. 57, pl. ii. figs. 7, 8.—Upper Keuper; Lumezzane, Lombardy. [University Museum, Padua.]

Fragmentary examples of *Pholidophorus* have also been recorded from the Rhætic of Scania by B. Lundgren, Minneskr. Kongl. Fysiogr. Sällsk. Lund, no. v. (1878), p. 32, pl. ii. figs. 63, 72.

A generically indeterminable mandibular ramus from the Lower Kimmeridgian of Nusplingen, Würtemberg, now in the Tübingen University Museum, is named *Pholidophorus dentatus* by F. A. Quenstedt, Der Jura (1858), p. 810, pl. c. fig. 13: E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii (1906), p. 180.

The specimens described as follows, and illustrated by beautiful figures, appear to the present writer to differ from the typical *Pholidophorus* solely in the remote position of the dorsal fin, which is situated as in the so-called *P. maacki* (p. 477). None of the fins, except the caudal, exhibit more than a few basal fulcra (with the possible exception of the anal fin of "*Lepidotus sibiricus*"); but in most examples even of the typical *P. bechei*, the minute fringe of fulcra is lost. In the diagnosis of the so-called *Baleiichthys*, Rohon does not mention any distinctive generic characters:—

Lepidotus sibiricus, J. V. Rohon, Mém. Acad. Imp. Sci. St. Pétersbourg, [7] vol. xxxviii. no. 1 (1890), p. 9, pl. i. fig. 12, pl. ii. figs. 23, 24.—Jurassic; Ust-Balei, Government of Irkutsk, Siberia. [Nearly complete fish; Imperial Academy of Sciences, St. Petersburg.] ? Ichthyokentema PS W 1941. A.M.N.H. (n) 8 p. 91

Baleiichthys graciosa, J. V. Rohon, *ibid.* p. 12, pl. i. fig. 8, pl. ii. fig. 15.—Ibid. [Ditto. Type species of *Baleiichthys*.]

Baleiichthys lata, J. V. Rohon, *ibid.* p. 13, pl. ii. fig. 14.—Ibid. [Ditto.]

The so-called *Pholidophorus stabianus* (O. G. Costa, Atti Accad. Pontan. vol. v. 1850, p. 309, pl. vii. figs. 3, 4), from the Upper Jurassic of Castellamare, near Naples, is probably referable to the Leptolepidæ.

Genus **THORACOPTERUS**, Bronn.

[Neues Jahrb. 1858, p. 21.]

Head, trunk, and squamation as in *Pholidophorus*. Pectoral fins excessively enlarged; pelvic fins comparatively small; dorsal fin small, opposed to the anal fin; caudal fin deeply forked.

T. sp. ? Bassani 1896 Pal. Ital. I p. 208 pls. 17 figs. a. Trias Italy.

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Haywardia jordani, n.g. n.s., V.M. Tanner, 1936, p. 83, pl. i. figg. 1-3. L. Trias: Idaho, U.S.A. Said by Dr. Dunkle to be ident. w *Bystrowiania* (p. 48)

Pholidophorus vallejensis am. Rhaetic Argentina R. Rusconi 1947 An. Soc. Cient. argent. 143 p. 43 f. 2-3. [Part. ½ fish.]

Ph. cuyanus sp. nov. C. Rusconi Trias Argentina 1946, Rev. Soc. Hist. Geogr. Cuyo 1 p. 13. Mus. Hist. N. Mendoza.

Pholidophorus cognatus, A. Robertson, 2. Journ. Geol Soc. vol. iii (1847), p. 114 (name only). — Jurassic; Brora, Sutherland.

Su H. Becker, Mittheil. Naturw. Vereins Neuvorpommern u. Rügen, vol. xxvi (1895), pp. 173-180.

Baleiichthys antiquensis sp. n. W. Sun. n. Shensi, H-T Liu, Acta. Pal. Sinica 3 p. 320. 1 pl. 1 ff. [Pal. Sc. Sinica]

see p.

= *Leptolepis* aff. *Voithii*, A.: F. Bassani & G. D'Erasmo, Mus. Soc. Natl. Sci. [3] vol. xvii (1912) p. 231, pl. iv. f. 4, 5. Also *Aethalion carolinii*, Bassani & D'Erasmo, ib. p. 238.

? *Thoracopterus* sp., Rec. Fish M. Trias, Brookvale N.S.W. (Mich. P. 15783.), R.T. Wade 1942. J. Proc. R.S. N.S.W 75 p. 144, pl. vii f. A.

1906. T. n. O. Abel, Jahrb. K.-K. Geol. Reichsanst. Wien, LVI. p. 37. t-f. pl. iii f.

Australosomus altisquamosus Bertin. Ann. Soc. Géol. Nord 458: figs 3-4, pls 14, 15. Betsiras, N.W. Madagascar.

Gigantopleurus lelleri, g. n. Abel 1906. Jb. K.K. Geol. Reichsanst. Wien. LVI. p.39, t-f. 6-8, pl. i-f. 6, pl. ii, pl. iii f. 2. U. Trias Lunz, L. Austria.

Australosomus sp. Estrais S.W. Madagascar L.P. Lehman et al 1959 Ann. Paléont. 45: 184 ff. 4 pl. iii f. A B.

Australosomus simplex S.A. S. Nielsen 1949, Paleoz. Groenl. p. 163, ff. 56 pls. viii-ix. Estrias Greenland. Copenhagen.

Australosomus pholidopleuroides S.A. S. Nielsen 1949. Paleoz. Groenl. 3 p. 170 ff. 57, pl. v f. 2. Estrais Greenland, Carp. fish. Copenh.

PHOLIDOPLEURIDAE

Mawsonia brookvalei, n.g. n.s. R.T. Wade, 1932, Ann. Mag. N.H. (10) ix, p. 473 pl. xiv. Imp. fish. Hawkesbury. N.S.W.: 1935, p. 70, ff. 33-43, pl. ix f. 3 & Lectot: Fish. Sydney Univ.

†PHOLIDOPLEURIDAE.

†*Australosomus* notes p. 166, *A. kochi* sp. n. Triassic Greenland p. 167 pls. xxvii–xxix, xxx fig. 4, xxxiv–xxxvi, xxxvii figs. 3–4, xxxviii fig. 1, text-figs., STENSIÖ Medd. Grønland 83 (3). 1932.

A. Kochi S. Nielsen 1949, Paleoz. Groenl. 3 p. 16 ff. 1-46, 49-55, pl. v f. 1. pls. vi, viii.

M. altus

M. mesleri

M. Stockleyi, s.n. H. Haughton 1936, p. 58, pl. vi. f. 1-2. Karoo. Tanganyika. Britain S.A.M. Capetown.

Thoracopterus niederristi, Bronn.

1858. *Thoracopterus niederristi,* H. G. Bronn, Neues Jahrb. p. 18, pl. iii.

1866. *Thoracopterus niederristi,* R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. p. 170, pl. iii.

Type. Imperfect fish; counterpart in British Museum.

The type species, attaining a length of about 0·11. Length of head with opercular apparatus probably exceeding the maximum depth of the trunk, and contained four times in the total length of the fish. External bones and postclavicular scales ornamented with close vermiculating rugæ of ganoine; mandibular teeth minute and stout. Pectoral fin-rays at least two-thirds as long as the trunk, the broad bases longitudinally striated; origin of dorsal fin three times as remote from the occiput as from the base of the caudal fin; anal much larger than the dorsal fin. Anterior dorsal scales rugose, these and the others of the flank of the abdominal region delicately crimped and serrated on the hinder margin; most of the caudal scales smooth and not serrated; four series of deepened scales on the flank of the abdominal region.

Form. & Loc. Upper Trias: Raibl, Carinthia.

P. 1098. Counterpart of type specimen; Raibl. The minute teeth are distinct in a fragment of the mandible; the operculum is only shown by an imperfect impression of its inner face. There are no traces of the pelvic fins. *Egerton Coll.*

Another imperfect fish from Raibl, very doubtfully distinct from *Thoracopterus,* but said to differ in wanting the pelvic fins (only one specimen examined), is named *Pterygopterus apus* by R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. lv. pt. i. (1867), p. 722, with plate. The pectoral fins from the Upper Trias of Giffoni, Province of Salerno, Italy, erroneously referred to *Urocomus picenus* by O. G. Costa, Atti R. Accad. Sci. Napoli, vol. vi. Append. (1862), p. 32, pl. v. fig. 2, are doubtfully ascribed to *Pterygopterus* by F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3 (1892), p. 10.

Genus **PHOLIDOPLEURUS,** Bronn.

[Neues Jahrb. 1858, p. 17.]

Trunk elongate-fusiform and upper caudal lobe inconspicuous. External bones nearly or quite smooth, with very thin ganoine; maxilla deepened behind, scarcely arched; teeth minute. Vertebral

centra annular. Fulcra wanting on the pectoral fins, confined to the bases of the median fins. Pectoral fins small, and pelvic fins absent; dorsal and anal fins opposed, acuminate in front, extended behind. Scales thick, with very thin ganoine; those of the middle of the flank excessively deepened, covering the greater part of it, each strengthened within by a broad rib and nearly all the scales exhibiting a peg-and-socket articulation; those of the ventral aspect numerous, broader than deep. Lateral line passing directly along the deepened flank-scales.

This genus is doubtfully ascribed to the Pholidophoridæ.

Pholidopleurus typus, Bronn.

1858. *Pholidopleurus typus*, H. G. Bronn, Neues Jahrb. p. 12, pl. i. figs. 11–15.

1866. *Pholidopleurus typus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. p. 176, pl. iv. fig. 2.

1886. *Pholidopleurus typus*, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. p. 36.

Type. Nearly complete fish.

The type species, attaining a length of about 0·1. Length of head with opercular apparatus scarcely, if at all, exceeding the maximum depth of the trunk, and contained about five times or slightly more in the total length of the fish. Anal fin with about 50 rays, arising at a point twice as distant from the pectorals as from the caudal; dorsal opposed to the hinder two-thirds of the anal fin, with about 40 rays. External bones and scales smooth, not serrated.

The outline-restoration published by Bronn (*loc. cit.* pl. ii. fig. 2), being founded on a distorted specimen, is too stout and with a relatively too large head. The confusion of *Peltopleurus* with *Pholidopleurus* is the source of the pelvic fins shown.

Form. & Loc. Upper Trias: Raibl, Carinthia, and Besano, Lombardy.

P. 1099 c, d. Two fine specimens, the first displaying all the fins, the second showing the small conical teeth in the maxilla. *Egerton Coll.*

P. 3618, P. 4409. Three fine specimens, the third vaguely showing the axial skeleton of the trunk. *Enniskillen Coll.*

33062. Four more imperfect specimens. *Purchased*, 1858.

Dimorpholepis lutoensis g. s. n. Karoo: Angola. C. Teixeira 1947, Broteria 16 (43) p. 58; 1948 Bol. Soc. Geol Portugal 7 3 pls.

Pholidopleuridae.

1910. *Pholidopleurus typus*, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 139, pl. ix. figs. 7, 10.
1935. *Pholidopleurus typus*, R. T. Wade, p. 66, fig. 32.

Arctosomus Berg 1941

A. sibiricus g. s. n. L. Berg 1941. Bull. Acad. Sci. URSS. No 3. 1941 p. 468 f. 18-24. L. Trias: Yenisei Siberia. [Fishes: Pal. Inst. Acad. Sci USSR.].

Peltopleurus nigrisus, s.n. Brough 1939, Trias Fishes Besano, p. 24, Hf. 9-10, 11b, pl. iv. f. 1-3. Trias. Lombardy [Fish.: Restor?

Peltopleurus lissocephalus, s.n. Brough 1939, ibid. p 29, Hf. 11a pl. iv. f. 4-6. Trias: Lombardy Basin [Fish.: B.M.].

Placopleurus Brough 1939.

Pla. posimus s.n. Brough 1939, ibid. p. 32, Hf. 12 (rest.) pl v. f. 1. Trias. Lombardy [Fish.: B.M.].

Plac. besanensis (Besano) Brough 1939, ibid p. 34, Hf. 13 pl. v f. 3-6.

1910. *Peltopleurus splendens*, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii. p. 142, pl. ix. figs. 3, 8.

Habroichthys Brough 1939

H. minimus, s.n. Brough 1939, ibid. p. 37, Hf. 14 pl v. f. 2. Trias. Lombardy [Fish.: BM.] : *Peltopleuridae*?

PELTOPLEURIDÆ.

Genus **PELTOPLEURUS,** Kner.

Brough 1939. p. 23.

[Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. 1866, p. 180.]

Trunk deeply fusiform. External bones nearly or quite smooth; maxilla more or less arched and the oral margin convex; teeth minute. Pelvic fins well-developed, but smaller than the pectorals; dorsal and anal fins short-based, the former arising in advance of the latter; caudal fin forked. Scales thick and moderately overlapping; those of the middle of the flank excessively deepened, covering nearly the whole of it; dorsal and ventral scales few, at least as deep as broad. Lateral line passing directly along the deepened flank-scales, inconspicuous.

Peltopleurus splendens, Kner.

1866. *Peltopleurus splendens*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. p. 180, pl. iv. fig. 3.

1886. *Peltopleurus splendens*, F. Bassani, Atti Soc. Ital. Sci. Nat. vol. xxix. p. 36.

Type. Nearly complete fish; Museum of Imperial Geological Survey, Vienna.

The type species, attaining a length of about 0·06. Length of head with opercular apparatus contained nearly five times, and maximum depth of trunk about three-and-a-half times in the total length of the fish; width of caudal pedicle scarcely exceeding one-third the depth of the deepest flank-scale. Operculum two-and-a-half times as deep as its maximum breadth. Pelvic fins arising at the middle point of the trunk, the anal very shortly behind, and the dorsal opposed to the intervening space. Scales smooth, not serrated.

Form. & Loc. Upper Trias: Raibl, Carinthia, and Besano, Lombardy.

Not represented in the Collection.

Peltopleurus kneri, sp. nov.

[Plate XIV. fig. 4.]

1858. *Pholidopleurus typus*?, H. G. Bronn, Neues Jahrb. p. 15, pl. i. fig. 16.

Type. Imperfect fish; British Museum.

A species about as large as the type, but with smaller head and more elongated trunk. Length of head with opercular apparatus contained six times in the total length of the fish. Pelvic fins arising much in advance of the middle point of the trunk, and the

anal midway between these and the caudal. Scales smooth, not serrated.

Form. & Loc. Upper Trias: Raibl, Carinthia.

P. 1099 a. The type specimen, counterpart of specimen described and figured by Bronn, *loc. cit.* *Egerton Coll.*

P. 1099 b. A more imperfect, vertically-crushed fish, shown of the natural size in Pl. XIV. fig. 4; displaying one median and one paired series of scales above the deepened flank-scales, also the situation of the very short dorsal fin (*d*). *Egerton Coll.*

Peltopleurus humilis, Kner.

1850. *Semionotus curtulus*, O. G. Costa, Atti Accad. Pontan. vol. v. p. 294, pl. vi. figs. 4, 5 (in part).

1867. *Peltopleurus humilis*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. lvi. pt. i. p. 905, pl. i. fig. 2.

1892. *Peltopleurus humilis*, F. Bassani, Mem. Soc. Ital. Sci. [3] vol. ix. no. 3, pp. 12, 23.

Type. Imperfect fish; Innsbruck Museum.

A species much smaller than the type, with relatively large head and more elongated trunk. Length of head with opercular apparatus equalling the maximum depth of the trunk and contained about four times in the total length of the fish; width of caudal pedicle about equalling one-half the depth of the deepest flank-scales. Pelvic fins arising slightly in advance of the middle point of the trunk, the anal very shortly behind, and the dorsal opposed to the intervening space. Scales smooth, not serrated.

Form. & Loc. Upper Trias: Tyrol; Giffoni, Province of Salerno, Italy. Gallatto, near Laveno, Lago Maggiore.

P. 1103. Slab with two imperfect specimens, one in counterpart; Seefeld. *Egerton Coll.*

Another imperfect fish from Raibl, with horizontally striated flank-scales, now in the Museum of the Imperial Geological Survey, Vienna, is provisionally named *Peltopleurus gracilis* by R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. (1866), p. 183, footnote.

Genus **PLEUROPHOLIS,** Egerton.

[Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv. 1858), no. 7.]

Trunk elongate-fusiform, and upper caudal lobe conspicuous. External bones smooth or delicately ornamented with rugæ and

The specimen fig? by Brown is in Basle Museum.
A.S.W. Aug. 29th. 1898.

1895. Peltopleurus humilis, F. Bassani, Palaeont. Italica, 1895) vol. i. p. 207, pl. xii. fig. 10.
1914. Peltopleurus humilis, F. Bassani, Boll. R. Comit. Geol. Ital. vol. xliv. p. 101, with plate.

Peltopleurus orientalis s.n. M. Trias Kwaichow S.W. China F.T. Lee 1959 Vert. Palasiat. 3, 4: 205, pl. i. [Fish Acad Sinica].

Galleto, near Lavena, Lago Maggiore.

P. 11779. Imperfect fish in counterpart; Seefeld.
Pres? by Dr. A. P. Young, 1915.

Peltopleurus maeseni, M. Leriche, Ann. Mus. Congo Belge.
Comptes Rendus, vol. cli (19), p. 841; Rev. Zool. Africaine vol. i (1911), p. 193, pl. ix. — U. Trias; Kilindi, Congo.
[Imperfect fish; Congo Museum, Tervueren.]
"P. m." P. de Saint-Seine 1950 Ann. Mus. Congo Belge (8) Sci. Zoo. 5 p. 19 pl. 1. fig. h. (inc. sedis) = ? Callorhinchus passimi p. 360

1919. Pleurophlis attenuata, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 114, text-fig. 35A.

1919. Pleurophlis longicauda, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 119, pl. xxiv. figs. 1, 2, text-fig. 35B.

tuberculations; maxilla more or less arched and the oral margin convex; teeth minute. Vertebral centra annular. Fulcra present on all the fins. Pelvic fins well developed, but smaller than the pectorals; dorsal and anal fins longer than deep, opposite. Scales thick and moderately overlapping; those of the middle of the flank excessively deepened, covering nearly the whole of it, each strengthened within by a broad rib and exhibiting a peg-and-socket articulation; dorsal and ventral scales few, relatively small and rhomboidal. Lateral line deflected, passing down the second or third deepened flank-scale and then traversing the uppermost series of small ventral scales.

Pleuropholis attenuata, Egerton.

1854. *Pleuropholis attenuatus*, J. Morris (*ex* Egerton, MS.), Catal. Brit. Foss. ed. 2, p. 339 (name only).

1858. *Pleuropholis attenuatus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 7, p. 1, pl. vii. fig. 1.

Type. Nearly complete fish; *olim* Bristow Collection.

The type species attaining a length of about 0·05. Length of head with opercular apparatus slightly exceeding the maximum depth of the trunk and contained about five times in the total length of the fish; caudal pedicle slender, its width equalling about half the depth of the flank-scales in the middle of the abdominal region. Opercular bones smooth. Pelvic fins arising midway between the pectorals and the anal; dorsal fin with ten rays, arising directly opposite to the origin of the anal fin, which has at least twelve rays, and arises nearly midway between the pectoral and caudal fins. Scales smooth, not serrated.

Form. & Loc. Middle Purbeckian: Apsel Lane, near Sutton Mandeville.

Not represented in the Collection.

Pleuropholis longicaudata, Egerton.

1858. *Pleuropholis longicaudus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 7, p. 3, pl. vii. fig. 4.

Type. Nearly complete fish; *olim* collection of W. Brodie.

A fish not yet clearly distinguished from the type species, but apparently with slightly less deepened flank-scales.

Form. & Loc. Middle Purbeckian: Dorsetshire.

P. 1101. Imperfect specimen labelled by Egerton; Swanage. There are crushed remains of ring-vertebræ, and the origin of the dorsal fin appears to be directly opposed to that of the anal. *Egerton Coll.*

Pleuropholis crassicaudata, Egerton.

[Plate XIV. fig. 5.]

1858. *Pleuropholis crassicaudus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 7, p. 3, pl. vii. fig. 2.

Type. Imperfect fish; collection of Rev. P. B. Brodie.

A small, comparatively robust species attaining a length of about 0·06. Length of head with opercular apparatus about equalling the maximum depth of the trunk, and contained slightly more than five times in the total length of the fish; width of caudal pedicle equalling about two-thirds the depth of the flank-scales in the middle of the abdominal region. Pelvic fins arising midway between the pectorals and the anal; distance between the origin of the pectoral and anal fins nearly twice as great as that between the origin of the latter and the caudal. Scales smooth, not serrated.

This definition of the species is based upon the specimen recorded below.

Form. & Loc. Lower Purbeckian ("Insect Bed"): Durdlestone Bay, Swanage, Dorsetshire.

43615. Well-preserved fish shown of the natural size in Pl. XIV. fig. 5; in marl from the "Dirt Bed" series. The proportions of the head and relatively large eye are indicated, and the squamation is distinct. Of the fins only the dorsal is entirely wanting, and the others exhibit traces of fulcra. The scales are shown to be united by peg-and-socket articulation, and there are four series beneath the deepened flank-scales, while only two or three can be recognized above. The lateral line passes from the hinder angle of the cranium across the first (and perhaps the second) deepened flank-scale, is then deflected down the second (perhaps third) scale, and thence passes directly along the upper series of ventral scales, which are slightly deeper than those below.

Purchased, 1872.

P. 1101. Vertebra noticed A.S.W. 1919, p. 120.

40724. See p. 487 below.

P. 7664. Imperfect fish des? & fig? A.S.W. 1919, p. 120, pl. xxiv. fig. 2; Swanage. Purchased, 1895.

1919. Pleurospholis crassicauda, A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 118, pl. xxiii. figs. 12, 13.

43615. Des? & fig? A.S.W. 1919, p. 118, pl. xxiii. fig. 13.

P. 7647. Type specimen, des? & fig? A.S.W. 1919, p. 118, pl. xxiii. fig. 12; Durdlestone Bay. P. B. Brodie Coll.

1909. Pleuronectes latissima, M.S. Johnston. Gord. Mag. [5] vol. vi. p. 309. pl. xiii.

P.10711. Nearly complete fish, desc. & fig. loc. cit. 1909; Kelheim. Pres. by Miss Mary S. Johnston. 1909.

1949. P.L.P. de Saint-Seine N. arch. Mus. H.N. Lyon 2 p. 249 ff. 111-113, pl. xxiv f. A. (Incl. P. obtusirostris P. egertoni. P. pompeckji B. ? = P. serrata].

Pleuropholis lævissima, Egerton.

1834. *Pholidophorus lævissimus*, L. Agassiz, Poiss. Foss. Feuill. p. 10 (name only).
1844. *Nothosomus lævissimus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 289 (name only).
1851. *Nothosomus lævissimus*, A. Wagner, Abh. k. bay. Akad. Wiss., math -phys. Cl. vol. vi. p. 63.
1858. *Pleuropholis lævissimus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 7, p. 3, pl. vii. fig. 3.
1863. *Pleuropholis lævissima*, A. Wagner, *loc. cit.* vol. ix. p. 668.
1863. *Pleuropholis egertoni*, A. Wagner, *ibid.* p. 670. [Name given to specimen figured by Egerton.]

Type. Imperfect fish ; Palæontological Museum, Munich.

An imperfectly defined species attaining a length of 0·13. Proportions very similar to those of the type species, but width of caudal pedicle equalling about two-thirds the depth of the flank-scales in the middle of the abdominal region, and origin of anal fin much more remote. Scales smooth, not serrated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone) : Bavaria.

P. 1100. Small specimen figured by Egerton, *loc. cit.* ; Kelheim. There is a false appearance of slenderness due to the fact that the dorsal and ventral scales are partly broken away or obscured by matrix. The curiously-deflected lateral line is well shown. *Egerton Coll.*

P. 3598. Another small imperfect specimen, partly distorted and shown from the ventro-lateral aspect ; Kelheim. *Enniskillen Coll.*

P. 3615. Remains of a larger fish, probably of this species ; Kelheim. *Enniskillen Coll.*

Pleuropholis thiollieri, Sauvage.

1873. *Pleuropholis*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. pl. vi. fig. 6.
1883. *Pleuropholis thiollieri*, H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. xi. p. 499.

Type. Nearly complete fish ; Lyons Museum.

A species attaining a length of about 0·12. Length of head with opercular apparatus about equalling the maximum depth of the trunk and contained nearly five-and-a-half times in the total length

of the fish; caudal pedicle slender, its width equalling two-thirds the depth of the flank-scales in the middle of the abdominal region. Pelvic fins arising midway between the pectorals and the anal; the latter fin arising slightly behind the middle point between the pectorals and the caudal. Scales smooth, not serrated.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 4691 b, c. Two fragments; Cirin, Ain. *Purchased*, 1884.

Pleuropholis obtusirostris, Sauvage.

1883. *Pleuropholis obtusirostris,* H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. xi. p. 501, pl. x. fig. 2.

Type. Nearly complete fish; Lyons Museum.

A small fish about 0·065 in length, possibly young of the preceding species. Length of head with opercular apparatus about equalling the maximum depth of the trunk and contained five times in the total length of the fish; width of caudal pedicle, scales, and arrangement of pectoral, pelvic, and anal fins as in *P. thiollieri*; dorsal fin arising slightly behind origin of anal.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 4691. Imperfect fish, wanting fins, but displaying the course of the lateral line along the inferior scales; Cirin, Ain. *Purchased*, 1884.

Pleuropholis lienardi, Sauvage.

1883. *Pleuropholis lienardi,* H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. xi. p. 501, pl. x. fig. 3.

Type. Nearly complete fish; Verdun Museum.

A species attaining a length of about 0·065. Length of head with opercular apparatus slightly exceeding the maximum depth of the trunk, and contained nearly five times in the total length of the fish; width of caudal pedicle equalling two-thirds the depth of the flank-scales in the middle of the abdominal region. Distance between origin of anal fin and that of the caudal scarcely exceeding half that between the former and the pectorals; dorsal fin arising slightly in advance of the anal. Scales smooth, not serrated.

Form. & Loc. Portlandian: Dept. Meuse, France.

Not represented in the Collection.

Pleurophoolis formosa, A.S. Woodw.

1919. *Pleurophoolis formosa*, A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 115, pl. xxii. fig. 8, pl. xxiii. figs. 8–11, text-fig. 36.

Form. & Loc. L. Purbeck: Jeffont, Wilts.

P. 10986. A group of fishes including the type specimen des? & fig? A.S.W. 1919, p. 115, pl. xxiii. fig. 8; also anal fin des? & fig? A.S.W. 1919, p. 116, pl. xxiii. fig. 11; Jeffont. Purchased, 1911.

P. 10955. Imperfect fish, head des? & fig? A.S.W. 1919, p. 116, pl xxiii. fig. 9; Jeffont. Pres? T.J. Gething, Esq. 1911.

P. 9851. Imperfect fish, vertebræ noticed A.S.W. 1919, p. 116, pectoral fulcra des? & fig? A.S.W. 1919, p. 116, pl. xxiii. fig. 10; Jeffont. Pres? Rev. W.R. Andrews, 1903.

P. 6304. Imperfect fish, fulcra on anal fin noticed A.S.W. 1919, p. 117; Jeffont. Pres? Rev. W.R. Andrews, 1890.

P. 9846. Immature fish des? & fig? A.S.W. Geol. Mag. [4] vol. ii (1895). p. , pl. , fig. , and A.S.W. 1919, p. 117, pl. xxii. fig. 8; Jeffont. Pres? Rev. W.R. Andrews, 1903.

1919. Pleuropholis serrata, A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 120, text-fig. 35 c,D.
? lacl. P. Thiollieri

Pl. bassei sp. nov. U. Senonian, Yemen J.P. Lehman. — 1954, Bull. Soc. géol. France (6) 4 p. 661, ff. 3, pl 26.

Pl. jamotti s.n. } Saint-Seine 1955 Ann. Mus. Congo belge, Géol. 14
Pl. Tannoyi s.n. } p. 79 (err. Figs 62-66, pl. x f. 6-d } Kimmeridgian: Congo. Fishes: Mus. Congo.
p. 85 " 67

P. koeni, n.s.
P. wagneri n.s. W. Beise, 1927. Neues Jahrb. LVIII, Beilage bd., Abt. B. p. 85 pls v & viia Solenhofen Lithogr. Sch.: Kapfelberg, Bavaria. (Imp. fish.: G.P.I. Berlin)
P. pompecki n.s. W. Beise 1927. ibid. p. 89 pls. vi & vii b. ibid [ibid: do] = P. Thie
Pleuropholis sp., R.H. Traquair, Poiss. Wealden Bernissart (Mém. Mus. Roy. Hist. Nat. Belg. vol. V. 1911), p. 45, pl. ix. figs. 1-3. — Wealden; Bernissart, Belgium.

P. 4691a. Dorsal ridge-scales noticed, A.S.W. 1919. p. 117.

40724 is referred to P. longicauda by A.S. Woodward, Fos. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 120, pl. xxiv. fig. 1.

Paraspleuropholis g. nov.

Pa. albrechti s.n. } Saint-Seine 1955 sylva pl. xi Kimmer. Congo
Pa. koeni s.n. } P. 69 ff. 66-77, pl. xi } Fish. Mus. Congo
P. 48 ff 78. pl. xii f. a.

Austro pleuropholis g. nov. pl. xii f. b
R. lombardi n. Saint-Seine 1955 ibid. p. 99. ff 77-82 Purb. Wealden Co

Pleuropholis serrata, Egerton.

1858. *Pleuropholis serratus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. ix. (Mem. Geol. Surv.), no. 7, p. 5, pl. vii. figs. 5–9.

Type. Imperfect fish; *olim* collection of Dr. John Lee, Hartwell.

A species attaining a length of about 0·1. Length of head with opercular apparatus about equalling the maximum depth of the trunk, and contained five times in the total length of the fish; width of caudal pedicle slightly exceeding one-half the depth of the flank-scales in the middle of the abdominal region. Distance between origin of anal fin and that of the caudal scarcely exceeding half that between the former and the pectorals; dorsal fin arising opposite or just behind the origin of the anal. Scales smooth, but those of the deepened series with fine oblique serrations.

Form. & Loc. Purbeckian: Buckinghamshire.

40316–17. Two imperfect fishes, the second wanting the head but displaying portions of all the fins; Bishopstone.
Purchased, 1867.

P. 1102. Two fragments; Hartwell. *Egerton Coll.*

Fragmentary remains of a species of *Pleuropholis* with serrated flank-scales, much resembling *P. serrata* and not yet distinguished from it, have been obtained from the Lower Kimmeridgian (Lithographic Stone) of Cirin, Ain, France. One imperfect fish in the Lyons Museum is figured by Thiollière, Poiss. Foss. Bugey, pt. ii. (1873), pl. vi. fig. 5, and subsequently described under the name of *P. egertoni*, H. E. Sauvage (*non* Wagner), Bull. Soc. Géol. France, [3] vol. xi. (1883), p. 498, pl. xiii. fig. 1. The following is a specimen of the same form :—

P. 4691 a. Imperfect fish originally about 0·07 in length, the head and abdominal region and serrated flank-scales displaced; Cirin. *Purchased,* 1884.

The following specimen is not specifically determined :—

40724. Head and abdominal region of a comparatively large fish with small head and deep trunk; Purbeck Beds, Swanage. The head with opercular apparatus measures 0·015 in length, and the depth of the deepened scales above the region of the pelvic fins is 0·013. The scales are smooth, none serrated. *Purchased,* 1867.

Archaeomemus ! Goodrich
Lank. Zool. IX p. 337.

Genus **ARCHÆOMÆNE,** A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9.]

Trunk elegantly fusiform and laterally compressed, with conspicuous upper caudal lobe. Head small and snout obtuse; one large suborbital occupying the greater part of the cheek behind the orbit; oral border of maxilla convex; teeth all small, those of the margin of the jaws arranged in close regular series. Notochord persistent; hypocentra and pleurocentra rudimentary or absent; ribs long and slender. Fulcra small on all the fins. Pelvic fins nearly as large as the pectorals; dorsal and anal fins acuminate and opposed, the former short-based, the latter more extended; caudal fin forked. Scales thin, deeply imbricating, and almost cycloidal, those of the flank not deepened, and those of the dorsal and ventral aspect about as deep as broad; conspicuous obtuse ridge-scales dorsally and ventrally.

Archæomæne tenuis, A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9, with drawings on pl. ii. figs. 5, 6.]

Type. Fish; Museum of Geol. Surv. N. S. Wales, Sydney.

The type species, commonly attaining a length of about 0·12. Head with opercular apparatus occupying somewhat less than one-fifth of the total length of the fish; maximum depth of trunk equalling about one-third of the length from the pectoral arch to the base of the caudal fin. Pectoral fin with from 10 to 12 rays, the foremost especially stout; pelvic fins arising midway between the pectorals and the anal, each with about 6 rays; dorsal fin comprising about 10 rays, arising behind the middle point of the back directly opposite to the origin of the anal, which has not less than 14 rays. Scales exhibiting only the concentric lines of growth.

Form. & Loc. Upper Hawkesbury-Wianamatta Series: Talbragar, N. S. Wales.

Not represented in the Collection.

Archæomæne robustus, A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9, with drawings on pl. v. figs. 2–4.]

Type. Head with part of abdominal region; Museum of Geol. Surv. N. S. Wales, Sydney.

A species commonly attaining a length of about 0·2. Head with opercular apparatus occupying about one-fifth of the total length of

S.O. Cenogenoidei

Incl. Archaeomaenidae + Aphrelepidae p. 64

Archaeomaenidae Wade 1941
(Archaenemidae Goodnight)

A. L. R. T. Wade 1941. J. Proc. R.S. N.S.W 75 p. 73 Cf. 1-4, pl. ii (Rest.).

Madariscus g. n. Wade 1941.

1941. Madariscus robustus R. T. Wade, J. Proc. R.S. N.S.W 75 p. 76 Cf. 5 pl. iii f. 2. (Type sp.)

1919. Ceramurus macrocephalus, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917). p. 111, pl. xxii. fig. 7.

P.7639. Type specimen, in counterpart; M. Purbeck, Linton, Vale of Wardour. Fig? A.S.W. 1919. Brodie Coll.

P.9850. Anterior portion of smaller fish; L. Purbeck, Tefford. Pres? by Rev. W. R. Andrews. 1903.

P.7506. Imperfect fish; Purbeck Beds, near Weymouth. Purchased, 1895.

the fish; maximum depth of trunk equalling nearly one-half of the length from the pectoral arch to the base of the caudal fin. Dorsal fin comprising about 10 rays, arising at the middle point between the occiput and the base of the caudal fin, opposite the origin of the anal fin, which has not less than 14 rays. Scales exhibiting only the concentric lines of growth.

Form. & Loc. Upper Hawkesbury-Wianamatta Series: Talbragar, N. S. Wales.

Not represented in the Collection.

Genus **CERAMURUS,** Egerton.

[Brodie's Foss. Insects, 1845, p. 17.]

Trunk not much deepened and head relatively large; notochord persistent, surrounded with spaced ring-vertebræ; ribs short and delicate. Fin-fulcra few, long and slender. Pectoral and pelvic fins of moderate size; dorsal and anal fins not extended, the former in advance of the latter. [Flank-scales unknown, but] a series of robust ganoid ridge-scales on both borders of the hinder half of the caudal region.

Ceramurus macrocephalus, Egerton.

1845. *Ceramurus macrocephalus*, Sir P. Egerton, in Brodie's Foss. Insects, p. 17, pl. i. fig. 2.

1895. *Ceramurus macrocephalus*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 401.

Type. Nearly complete fish; collection of Rev. P. B. Brodie.

The type species, known only by a unique specimen 0·043 in length. Length of head with opercular apparatus about twice as great as the maximum depth of the trunk, and contained about four times in the total length of the fish. Dorsal fin with about 10 rays, opposed to the pelvic pair; anal with about 8 rays, completely behind the dorsal. Ridge-scales of upper caudal lobe especially acuminate and each produced into a long point.

Form. & Loc. Purbeckian: Vale of Wardour, Wiltshire. Weymouth.

~~Not~~ represented in the Collection.

Some indeterminable immature Triassic fishes, not represented in the Collection, but sometimes compared with the Pholidophoridæ, sometimes with the Leptolepidæ, bear the undefined generic name of *Prohalecites* (W. Deecke, Palæontogr. vol. xxxv. 1889, p. 125). Two forms are distinguished as follows:—

Prohalecites microlepidotus: *Pholidophorus microlepidotus*, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii.

pt. i. (1866), p. 183, pl. ii. fig. 3; W. Deecke, Palæontogr. vol. xxxv. (1889), p. 126.—Upper Trias; Raibl, Carinthia. [Museum of Imperial Geological Survey, Vienna.]

Prohalecites porro, W. Deecke, *loc. cit.* p. 125, pl. vii. figs. 5–7. *Pholidophorus porro*, C. Bellotti, in A. Stoppani, Studii Geol. e Paleont. Lombardia (1857), p. 430; O. G. Costa, Ittiol. Foss. Ital. (1873), p. 65, pl. v. fig. 9.—Upper Trias; Perledo, Como. [The type species of *Prohalecites*. Milan Museum.]

Either to the Pholidophoridæ or to the Leptolepidæ may also probably be referred the unique fragmentary fossil described as follows:—

Megalopterus raiblianus, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. liii. pt. i. (1866), p. 174, pl. iv. fig. 1.—Upper Trias; Raibl, Carinthia. [Imperfect caudal region; Imperial Geological Survey Museum, Vienna. The type species of *Megalopterus*.]

Family OLIGOPLEURIDÆ.

Trunk fusiform. Head with delicate membrane-bones, scarcely, if at all, enamelled; mandibular suspensorium nearly vertical or inclined forwards, and gape of mouth wide; teeth small or of moderate size. Vertebral centra well-ossified, with no distinct pleurocentra and hypocentra in any part of the column; large free neural spines in the abdominal region; ribs short; no fused or expanded hæmal arches at the base of the tail. Intermuscular bones rare or absent. Fin-fulcra present; dorsal and anal fins acuminate in front, of variable length. Scales thin, more or less rounded, and deeply imbricating.

Synopsis of Genera.

I. Dorsal fin short-based.
- Vertebral centra not pitted; mandible prominent; dorsal opposed to anal fin ..... *Oligopleurus* (p. 491).
- Vertebral centra with two lateral pits; mandible not prominent; greater portion of dorsal in advance of anal fin..... *Oeonoscopus* (p. 494).

II. Dorsal fin extended.
- Vertebral centra with two lateral pits; fulcra on all fins; anal fin short, opposed to hinder end of dorsal; caudal fin forked .. *Spathiurus* (p. 498).

Prohalecites porroi, G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 137, pl. ix. figs. 4, 5.

Prohalecites sp. Bruyl, 1939 Trans. Roy. Soc. Canada, p. 107.
Griffith, 1977, Zool. J. Linn. Soc., 60, p. 81

For so-called Pholidophoridae *Etringus* and *Sandalodus*, see Part IV, p. 159, this.

Gaskinia n.g. type *G. nuda* Berg, 1940 Trans. Pal. Inst., Akad. Sci. USSR 15 (1), p. 37. see D.V. Obruchev 1956 Geol. Sbornik, Lvov 2-3 p. 344.

1943,
O. groebberi A.F. Bordas Physis 19, p. 317 pl. 1
H. cetac. Chubut. Argentina. Fish. Mus. Arg. C.N.

The undefined generic name of *Holochondrus* is mentioned by Thiollière immediately after *Oligopleurus* (Poiss. Foss. Bugey, pt. i. 1854, p. 4), but nothing is known of the fish to which it refers.

Genus **OLIGOPLEURUS**, Thiollière.

[Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii. 1850, p. 154.]

Head large and snout pointed; maxilla arched, with convex oral border; dentary truncated in front and mandible prominent; all teeth minute. Gill-rakers large and closely arranged. Vertebral centra in part deeper than long, longitudinally striated, but without lateral pits; ribs delicate. Fin-rays robust, all closely articulated and divided at some distance from the base; fulcra conspicuous on the median fins. Dorsal and anal fins short-based, nearly or completely opposed; caudal fin gently excavated at its hinder border. Scales large.

The cranial osteology of this genus is imperfectly known and best illustrated by the specimens enumerated below from the Wealden of the Isle of Wight and the Purbeckian of Swanage[1]. The head is of triangular shape and much laterally compressed. In *Oligopleurus vectensis* the cranial roof is broadest at the occipital border and gently arched from side to side; it exhibits a longitudinal median depression attaining its maximum depth and greatest breadth immediately behind the interorbital region, and gradually becoming shallower in front and behind. There is no ossified interorbital septum, and the middle portion of the parasphenoid is narrow, apparently without teeth. The mandibular suspensorium is somewhat inclined forwards, but the gape of the mouth is wide, the mandible projecting in front of the premaxilla. The hyomandibular is much constricted mesially, laterally compressed above, and antero-posteriorly compressed below. The quadrate is fan-shaped, constricted immediately above the articular condyle, and with a cleft near its hinder border for the reception of the symplectic; there is also a curious inwardly-directed process from the base of the condyle. There are the usual three pterygoid elements on each side, but rather delicate. The premaxilla is very small. The maxilla is a long, narrow, laterally compressed, and gently arched bone, of almost uniform depth, except in its anterior third, which gradually contracts and ends in a stout inwardly-directed process; the oral border is convex, and the hinder two-thirds of the

[1] See figures and description in Proc. Zool. Soc. 1890, pp. 346–350, pls. xxviii., xxix.

superior border exhibit a deep narrow depression, overlapped by two supramaxillary bones, which are arranged like those of *Pholidophorus* and the Clupeoids. Only two elements have been observed in the mandible, a short articular bone behind and a long dentary forwards; these meeting in a high coronoid elevation, which is chiefly formed by the dentary. The teeth are small and conical, and seem to have been more or less clustered on the margin of the jaws. The cheek-plates are very delicate, but appear to have covered the whole of the circumorbital space. The opercular apparatus is complete, and the preoperculum is considerably exposed, marked with radiating ridges. Branchiostegal rays are also well-developed, but no gular plate has been observed. The branchial arches are remarkable on account of the great size of the gill-rakers, which are smooth pointed stylets of bone, slightly constricted near the base and arranged in very close series.

The vertebral centra are completely ossified, amphicœlous, usually deeper than broad, and marked on the side by fine transverse striations extending between a thickened rim anteriorly and posteriorly; a pair of deep pits on the upper aspect accommodates the neural arch, and there is a similar pair of pits on the ventral aspect for the insertion of a hæmal arch. The only traces of attached peripheral elements hitherto observed consist in a small, faint, rounded pit or rugosity on some of the anterior centra, which may have supported an intermuscular bone. The first vertebral centrum, articulating with the basioccipital, is composed of two thin discs fused together, the anterior supporting the neural, the posterior the hæmal arch. The other centra exhibit no suture. The neural spines are free from their supporting arches in the abdominal region and comparatively robust; those of the caudal region are slender and fused with the delicate low arches, which have prominent zygapophyses. The ribs are short and delicate.

Oligopleurus esocinus, Thiollière.

1850. *Oligopleurus esocinus*, V. Thiollière, Ann. Sci. Phys. & Nat. Lyon, [2] vol. iii. p. 154.

1854–73. *Oligopleurus esocinus*, V. Thiollière, Poiss. Foss. Bugey, pt. i. pl. ix., pt. ii. p. 21.

Type. Nearly complete fish; Lyons Museum.

The type species, attaining a length of at least 0·45. Length of head with opercular apparatus nearly equal to the maximum depth of the trunk and almost one-quarter of the total length of the fish; depth of trunk at pectoral arch comprised nearly six times in the total length. Anterior abdominal vertebral centra somewhat

1949. B.C. P. de Saint-Seine n. Arch. Mus. H.N. Lyon 2me p. 246 Hf. 110 pl. xxiv. f. B.

Fam. Leptolepidæ.

Genus Pachythrissops, A. S. Woodw.

[Fos. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 128.]

Syn. Parathrissops, C. R. Eastman (non Sauvage, 1875), Mem. Carnegie Mus. Pittsburgh, vol. vi. 1914, p. 423.

1911. Oligopleurus vectensis, R. H. Traquair, Foss. Weald. Berniszart (Mém. Mus. Roy. Hist. Nat. Belg., vol. v), p. 47, pl. x.

1913. Oligopleurus vectensis, E. S. Goodrich, Proc. Zool. Soc. p. 84.

1919. Pachythrissops vectensis, A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 133, pl. xxiv. figs. 6, 7, pl. xxv. figs. 4, 5; text-fig. 40.

42013 des? & fig? A. S. W. 1919, p. 133, pl. xxv. f. 5; text-f. 40.

Pachythrissops macrolepidotus, s. n. H. Weitzel, Pal. Zeitsch. v. vol. xv. (1933) p. 22, 4 figs. (Sth. Slake). Fish. Ctes. Lancs. nuneum

Pachythrissops lævis, A. S. Woodw.

1919. Pachythrissops lævis, A. S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1917), p. 129, pl. xxiv. f. 3–5, pl. xxv. f. 1–3. [For the Purbeck fossils.]

1973 P. lævis, P. L. Forey, Bull BM (Geol.) Suppl. 10, p. 89, figs 44, 45.

40433 is type specimen of P. lævis, A. S. W. 1919, p. 129, pl. xxv. fig. 1.

P. 12212. Roof of skull des? & fig? A. S. W. 1919, p. 129, pl. xxiv. fig. 3; Swanage. Purch? 1918.

P. 4219 des? & fig? A. S. W. 1919, p. 129, pl. xxiv. fig. 4.

44845. Imperfect fish, portion of trunk des? & fig? A. S. W. 1919, p. 132, pl xxiv. fig. 5; Swanage.

P. 45-35–36. See p. 529.

Review of Pachythrissops, P. Forey 1973, B.M.N.H. (Geol.) Suppl. no. 88-93

deeper than long, the others mostly as long as deep. Pelvic fins arising midway between the pectorals and the anal; dorsal fin scarcely larger than the anal, and arising slightly in advance of the latter.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Cirin, Ain, France.

Not represented in the Collection.

Pachythrissops

Oligopleurus vectensis, A. S. Woodward.

1890. *Oligopleurus vectensis,* A. S. Woodward, Proc. Zool. Soc. p. 346, pl. xxviii. fig. 1 (? pl. xxviii. figs. 2–4, pl. xxix. figs. 1–3).

Type. Skull with anterior vertebræ; British Museum.

A species attaining a size at least twice as large as the type, known only by the head and anterior vertebræ. The vertebræ are much deeper in proportion to their length than those of *O. esocinus.*

Form. & Loc. Wealden: Isle of Wight. (?) Purbeckian: Dorsetshire. Berniszart, Belgium.

42013. Type specimen, described and figured *loc. cit.*; Wealden, Isle of Wight. *Purchased,* 1870.

42014. Fragmentary portions of head and anterior vertebræ in sandstone, noticed *loc. cit.*; Wealden, Isle of Wight. *Purchased,* 1870.

The undermentioned specimens from the Purbeck Beds of Swanage are only provisionally assigned to this species. The large dentary bone (No. 36083) seems to be comparatively shorter and stouter than that of the type specimen of *O. vectensis*; otherwise it is difficult to recognize any mark of specific distinction between the Wealden and Purbeckian fossils.

3/

40433. Immature fish 0·2 in length, described and figured *loc. cit.* p. 349, pl. xxix. fig. 3. The length of the head with opercular apparatus is contained slightly more than four times, and the depth of the trunk at the pectoral arch nearly seven times in the total length of the fish. The origin of the dorsal fin appears to be exactly opposite to that of the anal, and these two fins are about equal in size. The caudal pedicle seems to have been relatively more slender than in *O. esocinus.* *Cunnington Coll.* (?).

P. 4219. Imperfect head and anterior vertebræ, described and figured as *Lepidotus minor* by Agassiz, Poiss. Foss. vol. ii. pt. i. p. 269, pl. xxix *c.* fig. 12, assigned to *Oligopleurus vectensis* by the present writer, *loc. cit.* p. 346, pl. xxviii.

figs. 2, 3, pl. xxix. fig. 1. The drawing given by Agassiz is very unsatisfactory, and the remarkable bony gill-rakers, with the compound first vertebra and the anterior portion of the right dentary, are re-figured by the present writer. The large and broad ascending process of the dentary behind its tooth-bearing margin is well seen; and the ceratohyal supports slender, widely-spaced branchiostegal rays. *Enniskillen Coll.*

21974. Imperfect cranium and chain of thirteen anterior vertebræ, exposed from the left side. The first vertebral centrum, as in the previous specimen, appears to consist of two fused discs, the hinder alone bearing the rib-facette.
Pas. last noticed A.S.W. 1919, p. 130. *Purchased*, 1848.

36083. Left dentary bone as large as that of the type specimen of *O. vectensis*, shown from the outer aspect. The depth at the symphysis seems to be about the same in the two specimens, but the distance from the symphysis to the hinder margin of the ascending process is much the least in the present fossil. *Cunnington Coll.*
Fig.? A.S.W. 1919, p. 131, pl. xxv. fig. 2.

P. 1121. Fragment of small vertebral column, described and partly figured by the present writer, *loc. cit.* p. 349, pl. xxviii. fig. 4. *Egerton Coll.*

23407, 36082. Two portions of much larger vertebral column. *Purchased*, 1849, *and Cunnington Coll.*

50090. Anterior portion of very large vertebral column, and some head-fragments. *Purchased*, 1879.

24816. Detached vertebral centrum pierced by a mesial foramen for the passage of a remnant of the notochord. *Cunnington Coll.*

OEONOSCOPUS, Costa.

[Ittiol. Foss. Ital. 1853, p. 2 (*Ionoscopus*).]

Syn. *Attakeopsis*, V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. 1858, p. 784 (name only), and Poiss. Foss. Bugey, pt. ii. 1873, p. 22.
Macrorhipis, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. 1863, p. 723.

Head large and snout pointed; maxilla much deepened behind, with nearly straight dentigerous border; teeth of moderate size, stout and conical or styliform. Vertebral centra usually about as

Vertebral centrum des? & fig? A.S.W. 1919, p. 132, pl. xxv. fig. 3; Swanage.

1915: Aethalion gigas, L. M. Vidal, Bol. Instit. Geol. Espana, vol. , p. 22, pl. i. fig. 2.: Ref. g. L.F. Cavdal 1957. Not. com. Inst. geol. Espana 23 p. 8 p. i ii. f. 1.

A.A. ~~Oligosaurus~~ Aethalion gigas (Saurage).

1903. Aethalion gigas, H. E. Saurage, Mem. R. Acad. Cienc. Barcelona [3] vol. iv, no. 35, p. 14, pl. iii, fig. 2.

Type — Head & front part of abdominal region.

1973 Anaethalion gigas P. Forey, Bull BM (Geol.) Suppl. 10, fig 18E

For. & Loc. — Upper Jurassic (Kimmeridgian): Montsech, Lérida, Spain.

P. 10377-80. Four fragments from Santa Maria de Meyá. Purchased, 1906.

Oshunia brittis n.g, n.sp., Aprian, Chapada do Araripe, Ceara, Brazil, S. Wenz 1986, Bull. Mus. natn. Hist. nat. Paris (4) 8: C, no. 1, 77-88

1915. Oenoscopus petraroide, G. D'Erasmo, Paldeont. Italica, vol. xxi. p. 5, pl. ii. figs. 1, 2; text-figs. 18–21.

1906. Oenoscopus cyprinoides, E. Heinecke, Geol. u. Paldeont. Abhandl. vol. xii. p. 207, pl. xxvi. fig. 2, text-fig. 14.

1914. Oenoscopus cyprinoides, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 421, pl. lxv. fig. 1.

long as deep, and the side of each exhibiting a median longitudinal ridge with a deep pit above and below; ribs robust, but short. Fin-rays robust, all closely articulated and divided at some distance from the base; fulcra conspicuous on the median fins. Dorsal and anal fins short-based, the former almost or completely in advance of the latter; caudal fin much forked. Scales large.

Oeonoscopus petraroiæ, Costa.

1853. *Ionoscopus petraroiæ,* O. G. Costa, Ittiol. Foss. Ital. p. 2, pl. i.
1864. *Oeonoscopus petraroiæ,* O. G. Costa, Atti Accad. Pontan. vol. viii. p. 59, pl. viii.
1882. *Oeonoscopus petraroiæ,* F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 240.

Type. Imperfect fish; Geological Museum, University of Naples.

The type species, attaining a length of about 0·7, known only by a fragmentary specimen which seems to have a somewhat deeper abdominal region than the next species, also differing from the latter in the stouter teeth and slightly more forward position of the dorsal fin.

Form. & Loc. Cretaceous: Pietraroja, Province of Benevento, Italy.

Not represented in the Collection.

The original specimen at Naples is covered with large cycloidal scales, and these are ornamented in the exposed portion with delicate, parallel horizontal lines, which sometimes seem to terminate at the hinder margin in fine serrations. The teeth are, as shown by Costa, enamelled at the tip; but the crimping of the crown of the two hinder teeth is not quite so conspicuous as indicated in Costa's figure. The operculum is much deeper than broad, and the branchiostegal rays are slender. The dorsal fin exhibits biserial fulcra, and all the other fins are seen to be fulcrated, except the pectorals, which are too much crushed. The dorsal fin exhibits at least 24, while the anal has only about 12 supports.

Oeonoscopus cyprinoides (Wagner).

1863. *Oligopleurus cyprinoides,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 721, pl. vi.
1887. *Oenoscopus cyprinoides* [misprinted *esocinus*], K. A. von Zittel, Handb. Palæont. vol. iii. p. 232.

Type. Fish, wanting head; Palæontological Museum, Munich.

A species nearly as large as the type. Length of head with opercular apparatus nearly equal to the maximum depth of the

trunk and contained somewhat more than four times in the total length of the fish; caudal pedicle less than half as deep as the abdominal region. Teeth closely arranged in the maxilla and smaller than some of those in the dentary. Vertebræ at least 60 in number, nearly all those of the abdominal region conspicuously deeper than long. Pelvic fins arising much nearer to the anal than to the pectorals; dorsal fin with 20–22 rays, arising at the middle point between the occiput and the base of the caudal fin; anal fin with about 14 rays, nearly as deep as the dorsal and arising opposite the hinder portion of the latter.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

49142. Plaster cast of type specimen: Neukelheim.
Purchased, 1878.

37795. Fine specimen 0·55 in length, with imperfect head showing part of the maxillary and mandibular dentition; Solenhofen. *Häberlein Coll.*

37795 a. Scattered remains of the head with vertebral column, caudal fin, and other fragments of a somewhat larger fish; Solenhofen. The hyomandibular, maxilla, mandible, and some of the broad branchiostegal rays are displayed.
Häberlein Coll.

Oeonoscopus muensteri (Wagner).

1842. *Aethalion subovatus*, G. von Münster, Neues Jahrb. p. 42. [Fish; Palæontological Museum, Munich.]
1842. *Pachycormus elongatus*, G. von Münster, *ibid.* p. 43. [Ditto.]
1842. *Pachycormus latus*, G. von Münster (*non* Agassiz), *ibid.* p. 43. [Ditto.]
1842. *Pachycormus gibbosus*, G. von Münster, *ibid.* p. 43. [Ditto.]
1848. *Pachycormus muensteri*, C. G. Giebel, Fauna d. Vorwelt, Fische, p. 199 (substitution of name for *P. latus*, Münster).
1863. *Macrorhipis münsteri*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 724, pl. vii.

Type. Nearly complete fish; Palæontological Museum, Munich.

A form of fish not yet clearly distinguished from *O. cyprinoides*, much smaller than the typical specimens of the latter, and possibly its immature stage. The trunk may perhaps be somewhat stouter than in the last species and the lobes of the caudal fin broader.

This is described as the type species of *Macrorhipis*.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

1906. *Oenoscopus* cf. *münsteri*, E. Heinecke, Geol. u. Palaeont. Abhandl. vol. xii. p. 208.

1949. Œ. d. P. de Saint-Seine N. Arch. Mus. H.N. Lyon 2 p. 17 fig. 78-79, pl. xviii.

33477. Des? & fig? A.S. Woodward, Fos. Fishes Weald. & Purb. Form. (Pal. Soc. 1916, 17), 1918-19, p. 121, pl. xvii. fig. 8.

Oeonoscopus elongatus, C.R. Eastman, Ann. Carnegie Mus. vol. viii (1911), p. 185, pl. xi. — Litho. Stone; Cirin, Ain, France. [Nearly complete fish; Carnegie Mus. Pittsburgh.] Also C.R. Eastman, Mem. Carnegie Mus. vol. vi. p. 384, pl. lvi. figs. 2, 3. Ionoscopus eastmani nom. nov.: H.W. Fowler 1938 Not. Nat. 310: 4 (rubbish)

49131. Plaster cast of type specimen; Kelheim. *Purchased*, 1878.

P. 893. Imperfect fish wanting the greater part of the head, and with the trunk chiefly in impression; Kelheim.
Egerton Coll.

Oeonoscopus desori (Thiollière).

1858. *Attakeopsis desori*, V. Thiollière, Bull. Soc. Géol. France, [2] vol. xv. p. 784 (name only).
1873. *Attakeopsis desori*, V. Thiollière, Poiss. Foss. Bugey, pt. ii. p. 23, pl. xi.
1887. *Oenoscopus desori*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 232.

Type. Nearly complete fish; Lyons Museum.

The type species of the so-called genus *Attakeopsis*, attaining a length of about 0·35. Form and proportions as in *O. cyprinoides*, but vertebræ not more than 55 in number and mostly as long as deep.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Ain, France.

P. 4702. Fish 0·25 in length, with much-crushed head and the vertebral arches and fins partly disturbed: Cirin, Ain. There seem to be indications of fulcra on the paired fins, and those of the median fins are conspicuous. Each pelvic bone is shown to be expanded both proximally and distally. *Purchased*, 1884.

An undetermined species of *Oeonoscopus* also appears to be represented by the following specimen:—

33477. Right maxilla described and figured in Geol. Mag. [4] vol. ii. (1895), p. 151, pl. vii. fig. 9; Purbeck Beds, Swanage. *Purchased*, 1858.

The following species has also been named, but is not represented in the Collection:—

Oeonoscopus striatissimus: *Pachycormus striatissimus*, G. von Münster, Neues Jahrb. 1842, p. 43: *Macrorhipis striatissima*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1863), p. 726.—Lower Kimmeridgian (Lithographic Stone); Kelheim, Bavaria. [Fish wanting caudal fin; Palæontological Museum, Munich.]

Genus **SPATHIURUS,** Davis.

[Trans. Roy. Dublin Soc. (2) vol. iii. 1887, p. 502.]

Syn. *Amphilaphurus*, J. W. Davis, *ibid.* 1887, p. 504.

Head large and trunk not much tapering in the caudal region; [jaws and teeth unknown]. Vertebral centra usually about as long as deep, and the side of each exhibiting a median longitudinal ridge with a deep pit above and below. Fin-rays robust, all closely articulated and divided at some distance from the base; fulcra present on both median and paired fins. Paired fins large, the pelvics as deep as the anal; dorsal fin occupying the greater part of the back, and anal fin small, opposed to the hinder extremity of the latter; caudal fin slightly excavated at its hinder margin. Scales large.

Spathiurus dorsalis, Davis.

1887. *Spathiurus dorsalis,* J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. iii. p. 503, pl. xxxv. fig. 1.

1887. *Amphilaphurus major*, J. W. Davis, *ibid.* vol. iii. p. 504, pl. xxiv. fig. 2. [Caudal region; British Museum.]

Type. Imperfect trunk; British Museum.

The type species, attaining a length of not less than 0·35, imperfectly known. Caudal pedicle apparently more than half as deep as the abdominal region. Vertebræ somewhat deeper than long. Dorsal fin comprising about 45 rays, not extending quite to the caudal; anal fin with 10 rays, remote from the caudal and much nearer the pelvic fins.

Form. & Loc. Upper Senonian: Mt. Lebanon.

P. 4867. Type specimen described and figured *loc. cit.*; Hakel. There is no evidence of the extension of the anal fin beyond 10 rays. *Lewis Coll.*

P. 4746. Type specimen of the so-called *Amphilaphurus major*, described and figured *loc. cit.*; Hakel. The two pelvic fins are crushed together, and apparently regarded as one by Davis; the "horse-shoe-shaped" pelvic bone of his description is a misapprehension, the fragments preserved undoubtedly indicating a pair of normal pelvic bones expanded at each extremity. *Lewis Coll.*

P. 5995–96. Two examples of the middle portion of the trunk; Hakel. The first specimen shows especially stout neural

Spathiurus ovalis, *S. latus*, and *S. striatus*, H. Brahms, Die Fischfauna des Barrêmien bei Hildesheim (Inaug. Dissert. Tübingen, 1913-19).

1908. *Spathiurus dorsalis*, F. Priem, in J. de Morgan, Délégation en Perse.— Ann. d'Hist. Nat. vol. i. p. 5; pl. i. figs. 2-4. [Fragments; M. Cretaceous, Persia.]

Apsisonus megaluriformis is referred to *Leonozephus petraroiae* by G. D'Erasmo, Palaeont. Italica, vol. xxi (1915), p. 6.

Apsisonus squamosus s.n. Kramb. Goj. 895 Bjela Lygost. Akad 16 p. 10 pl iii. f. 154. Cetac. Mzgk. d'Erasmo 1946 p. 21 f. 4.

H. Becker, Mittheil. Naturw. Vereins Neuvorpommern u. Rügen, vol. xxvi (1895), pp. 173-180.
= *Stichopterus gracilis*, O. M. Reis, Rech. géol. min. chemin de fer de Sibérie, livr. 29 (1909), p. 18. See Part IV, p. 2. Also supra III, p. 23.

See Part IV. p. 28.

Calanopleurus brama D. S. Jordan (*errore*), 'Peixes cretaceos do Ceará e Piauhy' (Monogr. Serv. Geol. e Min. do Brasil vol. iii, 1923 (1921)). P. 7584 is thus fig.d pl. xi, fig. 2, & P. 7584, 15499, P. 7585 are described & pp. 44, 45.

spines in advance of the dorsal fin, and part of the rays apparently of the pectoral fin. The second specimen displays the considerable expansion of the laminæ of the neural and hæmal arches, the acuminate anterior portion of the dorsal fin with fulcra on the first ray, and the rounded form of the scales. *Lewis Coll.*

P. 5994. Imperfect head and anterior abdominal region with pectoral fin, apparently of this fish; Hakel. The head is too fragmentary for description and the vertebral centra are obscure. The pectoral fin-rays are broad, much divided and very closely articulated in the distal portion; fulcra occur on the anterior margin of the fin, and there are traces of slender basal bones. *Lewis Coll.*

It is still not possible to distinguish from *Spathiurus* the genus *Opsigonus* (D. G. Kramberger, in F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. 1882, p. 200), from the Cretaceous of the Island of Lesina, Dalmatia. It is not determined, however, whether this fish had a rounded or forked tail, whether fulcra are present or absent on any fin except the caudal, and whether or not there is a series of free neural spines in the abdominal region. The single known species is *Opsigonus megaluriformis* (Kramberger, *loc. cit.* p. 200, and Rad. jugoslav. Akad. vol. lxxii. 1885, p. 14, pl. iv. fig. 1, and Soc. Hist.-Nat. Croatica, vol. i. 1886, p. 125), the type specimen being preserved in the Geological Museum of the University of Agram. The name of *Opsigonus gracilis* is given by J. V. Rohon (Mém. Acad. Imp. Sci. St. Pétersbourg, [7] vol. xxxviii. no. 1, 1890, p. 11, pl. i. fig. 6) to a small Palæonisćid fish from the Jurassic of Ust-Balei, Government of Irkutsk, Siberia, now in the Museum of the Imperial Academy of Sciences, St. Petersburg.

The following specimens probably represent a member of the family Oligopleuridæ, but are too imperfect for precise determination:—

P. 7584. Fragment of trunk and fin labelled "*Calamoporus cylindricus*, Agass.," by Agassiz, evidently intended for *Calamopleurus cylindricus*, L. Agassiz, Edinb. New Phil. Journ. vol. xxx. (1841), p. 84, and Comptes Rendus, vol. xviii. (1844), p. 1012; Cretaceous, Province of Ceara, Brazil. The scales are cycloidal, very much imbricating and apparently longer than deep; the fin-rays are widely spaced and much divided distally. *History unknown.*

15499. Portion of similar but much larger squamation, exhibiting the canal of the lateral line penetrating the scales; Brazil. Completely ossified vertebral centra are shown in the section. *Purchased*, 1843.

P. 7585. Imperfect caudal pedicle and fin, with similar scales; Brazil. The fin-rays, 10 or perhaps 12 in number, are extremely robust, much divided, expanded, and closely divided distally. The largest measures 0·11 in length, and the fin seems to have been little if at all excavated at the hinder border. *History unknown.*

Family LEPTOLEPIDÆ.

Trunk elegantly fusiform. Head with delicate membrane-bones, the suborbital and circumorbital plates almost or completely covering the cheek, more or less enamelled; parietal bones meeting in the middle line; snout not produced; mandibular suspensorium nearly vertical or inclined forwards, but gape of mouth wide; premaxilla very small; maxilla large, loosely attached and with two well-developed supramaxillary plates; teeth small and conical. Opercular apparatus complete. Vertebral centra well-ossified, but always pierced by the notochord; ribs delicate; no fused or expanded hæmal arches at the base of the tail. Intermuscular bones present. Fin-fulcra absent; fin-rays more or less divided and articulated distally; dorsal and anal fins small, the former usually short-based, above or behind the pelvic pair. Scales thin, cycloidal and deeply imbricating, usually ganoid in their exposed portion; lateral line not observable.

Synopsis of Genera.

I. Dorsal fin in advance of anal fin, which is not much extended.
  Dentary bone sharply rising into a thickened obtuse elevation near its anterior end .. *Leptolepis* (p. 501).
  Dentary bone gradually deepening from the symphysis backwards without any marked thickening ..... *Aethalion* (p. 518).
II. Dorsal fin opposed to anal fin, which is much extended.
  Dentary bone as in *Aethalion* ..... *Thrissops* (p. 521).

Liguellidae (Halecostomi)

Liguella sheyei g.n. & n. Poll & Gosse-Serie 1958. Ann. Mus. Congo belge, Sci. Zool. 14. p. 103 Pl. 83, 84, pl. xviii f. a.t. Fish. Mus. Congo. Kinsh. Congo.

Majokiidae.

Majokia brasseuri, g.n. & n. Poll & Gosse-Serie 1958 p. 107 Pl. 85 pl. xvii cf. do. do.

Calamopleurus vestitus, D. S. Jordan & J. C. Brunner, Smithson. Miscell. Coll. vol. 7ii (1908), p. 19, pl. v. — Cretaceous; Ceará, Brazil. [Gen. indet. portion of fish; Museo Rocha, Ceará, & Stanford Univ.] = Brannerion vestitus, D. S. Jordan, Proc. Acad. Nat. Sci. Philad. 1919 (1920), p. 209. [T. of Brannerion.]

(Elopidae) (Pl 71) B. v. D'Erasmo 1938, p. 25, pl. iv. f. 2.

Leptolepids connected to Clupeoids Greenwood 1956

See Bonde 1940 Lloydia 3 no. 3 p. 153 (not central!).

Taxonomic revision, O. Nybelin 1974, Acta r. Soc. Sci. litt. gothoburg., Zool. 9.

also C. Patterson + D. E. Rosen, 1977, Bull. Am. Mus. nat. Hist. 158, no 2.

bonnel Limpo As. B. 1942 Ann. N.H. (11) 9.
p. 506 Kf. 2.

Leptolepis tabaiensis s.n. B. Schaefer Bull. A. M.
N.H. 89. 1. p. 12 pl. ii. U. Cabo. Brazil

Leptolepis Leanzai M. Botoyoful de Sacs 1949
p. 447 Kf. 2. ? Argentina

Leptolepis diesii g. nov. Cretaceous, Lena do
Crampa, Brazil R. da Silva Santos 1958 Not. Lena
geol. Brasil 105; p. 3 3 figs. 1 pl. [Fish]

Genus **LEPTOLEPIS**, Agassiz.

[Neues Jahrb. 1832, p. 146.]

Syn. *Ascalabos*, G. von Münster, Beitr. Petrefakt. pt. i. 1839, p. 112 (undefined).
Tharsis, C. G. Giebel, Fauna d. Vorwelt, Fische, 1848, p. 145.
Sarginites, O. G. Costa, Atti Accad. Pontan. vol. v. 1850, p. 285.
Megastoma, O. G. Costa, *ibid.* 1850, p. 287.

Head large and teeth minute; sclerotic ossified. Maxilla arched, with a slightly convex dentigerous border; mandible prominent, and dentary sharply rising into a thickened, obtuse elevation near its anterior extremity; preoperculum broad mesially, with a large inferior limb, marked with radiating ridges; suboperculum large, but smaller than the trapezoidal operculum, from which it is divided by an oblique suture. Vertebræ in the form of much-constricted cylinders, with little or no secondary ossification. Pelvic fins relatively large; dorsal fin about as long as deep, opposed to the pelvic pair or to the space between the latter and the anal; anal fin small, not much extended; caudal fin deeply forked. Scales completely covering the trunk; no enlarged or thickened ridge-scales.

The external bones and scales are covered with a very thin layer of ganoine, always smooth or only feebly rugose. The cranial roof is flattened in the middle, abruptly truncated behind, and very narrow between the orbits; the parietals are very small, and the suture between the much-elongated frontals is wavy. The parasphenoid is delicate. There is a series of large suborbital bones, and the sensory canal traversing them exhibits a number of short branches radiating downwards. This is observable both behind and in front of the orbit. The sclerotic ring is ossified. The premaxilla is small, and the long curved maxilla, having minute teeth on its convex oral margin, is contracted, though comparatively robust, at its loose anterior articulation. There are also two elongated supramaxillary bones, deeply overlapping the maxilla. The mandible is deep in the middle, and consists almost entirely (if not entirely) of two elements. The robust dentary bone is remarkable for the deep coronoid process rising nearest its anterior end; behind, and partly above it, is the large laminar angulo-articular element. The ceratohyal has the ordinary hour-glass form, but is noteworthy for the extension of a supplementary delicate straight rod of bone between its extremities on the upper side. The opercular apparatus is complete, and the sensory canal upon the preoperculum exhibits radiating branches resembling those of the suborbital line. The branchiostegal rays on the short epihyal are broad and imbricating, while those supported by the ceratohyal are spaced and delicate;

and there is no trace of a gular plate in any specimen examined by the present writer.

One pair of large supratemporal plates occurs behind the occiput, and the whole of the trunk is covered with imbricating cycloidal scales, which are distinctly invested with ganoine in their exposed portion. The vertebral centra are in the form of constricted cylinders, not completely severing the intervertebral portions of the notochord; and they are often strengthened in the later species by longitudinal streaks of bone on the periphery. The ribs are robust, extending almost or quite to the ventral border; and some specimens seem to show that they are attached to broad laminar parapophyses. The delicate neural arches in the abdominal region do not appear to have been fused with the centra, while the right and left halves are separate, and the short neural spines are loosely apposed to them. Both the neural and hæmal arches in the caudal region are fused with the vertebral centra and with their respective spines; and where the arch joins the spine there is sometimes a slight triangular expansion of the bone. Intermuscular bones are observed across the neural arches in the abdominal region.

The basal bones of the pectoral fin are unknown, but the pelvic fin-supports are often well exhibited. Each of the latter is triangular in form, tapering forwards and thickened on the outer border. There is nothing worthy of note in the supports of the median fins, except that the foremost two or three elements in the dorsal are sometimes fused together.

coryphaenoides (Bronn).

Leptolepis bronni, Agassiz.

1830. *Cyprinus coryphænoides*, H. G. Bronn, Neues Jahrb. p. 14, pl. i. fig. 1.

1832. *Leptolepis bronnii*, L. Agassiz, *ibid.* p. 146.

1833–44. *Leptolepis bronnii*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 13; pt. ii. pp. 133, 294.

1852. *Leptolepis constrictus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv.), no. 9, pl. ix. [Nearly complete fishes; Bath Museum.]

1858. *Leptolepis bronnii*, F. A. Quenstedt, Der Jura, p. 238, pl. xxxiii. figs. 8–11.

1874. *Leptolepis constrictus*, H. E. Sauvage, Rev. Sci. Nat. vol. ii. p. 418, pl. vii. fig. 4, and in Dumortier, Etudes Paléont. Dépôts Jurass. Bassin Rhône, pt. iv. p. 29.

1874. *Leptolepis affinis*, H. E. Sauvage, *ibid.* p. 419, pl. vii. figs. 5–9, and *op. cit.* p. 30. [Nearly complete fish.]

(?) 1874. *Leptolepis pronus*, H. E. Sauvage, *ibid.* p. 424, pl. vii. fig. 1 [Nearly complete fish.]

(?) 1874. *Leptolepis pachystetus*, H. E. Sauvage, *ibid.* p. 426, pl. vii. figs. 2, 3. [Nearly complete fish.]

L. sp. Patagonia. G. de Alessio 1936, pl. 4 fig. 89.

Leptolepis nevadensis, s.n. L. Bartel, 1941, J. Paleont. 15, p. 318 2 figs. L. Cret. Nevada. [Fish: Cal. Inst. Techn.].

Leptolepis opercularis sp. nov., G. Arratia Fuentes + A. Chang Ganido, 1975, Ameghiniana, 12: 350-358. U. Jurassic, Chile.

L. australis sp. n. (~~specific name changed to~~).
Rodrigo de Saez 1939. Not. Mus. La Plata.
4 Pal. Eq. p. 304-425 fig 3-12. Inst. Fish. U. Sur. Argentina.

L. patagonicus (1940) L. argentinus spp. nov.
R. de Saez ibid. 5 p. 300 fig. 1-3 & p. 303 fig 4
Regnl. U. Jurassic - Argentina.

L. schoewei spn. ? L. sinuatus (U. Lykins) Colorado.
D.H. Dunkle 1942 Sci. Publ. Cleveland Mus. N.H. 6
p. 61 pl. vi. [Fish; Kansas Un. Mus. Vert. Pal.].

L. Lamanensis sp. n. Neocom. Mexico. D.H. Dunkle &
M. Maldonado-Koerdell 1953 J. Washington Acad. Sci
43 10 p. 315 fig. 2. [Fish. Coll. M M-K]

L. coryphaenoides, O. Nybelin 1974, Acta r. Soc.
Sci. Litt. Gothoburg, Zool. 9, pp. 30-48, pls. 5-11,
figs. 3-8.
L. coryphaenoides, Patterson & Rosen 1977, Bull. Am. Mus.
nat. Hist. 158: figs 32, 33,
L. coryphaenoides, Patterson, 1975, Phil. Trans R. Soc. B.

1929. Liassolepis n.g. brauni, O. Jaekel. In separ. Labelle
{ Arbeit. Geol.-Pal. Inst. Univ. Greifsw. No 21. p. 9, ffs. 3, 4.
{ Mitt. Mecklenburg. geol. Landesanst. XX XVIII (N. F. III) p. 21, tf. 3, 3-4
1935. Leptolepis asyphaenoides, C. Arambourg, p. 13,
tf. 8, 9; pl. ii ff. 2, 3, 6. (Gaede).
1937. Leptolepis brauni, S. L. Rayner, p. 14 tfs. (Retro-skull
1938. L. _____ G. _____ G. Faber, Bull. Soc. Nat. luxembourg,
n.s. 32, 198, tf.
1952. L. b. B. Haug bes. Hbg. Zool. p. 26 pl. 59 ffs

Leptolepis normandica sp. n. O. Nybelin 1962, Ark. Zool.
(2) 15: 303-306
1974 L. normandica, O. Nybelin Acta r. Soc. Sci. litt. gothoburg
Zool. 9: 8-30, pls. 1-5, 9, 4, 30, figs 1-3, 7.

1892. *Leptolepis affinis*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. v. p. 389, pl. xvi. fig. 1 (reprinted in Bull. Soc. Sci. Yonne, vol. xlvii. 1893, p. 25, pl. i. fig. 1). [Nearly complete fish.]

Type. Nearly complete fish.

The type species, of small size, attaining a length of about 0·1. Head with opercular apparatus occupying somewhat less than one-fourth of the total length of the fish; depth of caudal pedicle exceeding one-third the maximum depth of the abdominal region. Width of operculum not quite equal to half the length of the head. Vertebræ about 40 in number, the centra elongated, forming thin, much-constricted cylinders; the neural and hæmal arches in the hinder half of the caudal region comparatively robust. Pelvic fins arising much nearer to the anal than to the pectorals, and comprising not less than 10 rays; dorsal with about 12 rays, arising immediately behind the pelvic pair and almost reaching a point opposite the origin of the somewhat smaller anal fin.

Though not strictly in accordance with the rules of nomenclature, it seems advisable to adopt the name of *bronni* for this species in honour of its discoverer. The present writer cannot recognize any diagnostic characters in the English and French fossils separating them from the typical fishes of similar age in Germany; all of the features noted by Sauvage being readily explained by differences in the state of crushing and preservation.

Form. & Loc. Upper Lias: Baden, Würtemberg, and Bavaria; Normandy, Burgundy, and Lozère; Somersetshire.

19641–44. Two imperfect and distorted specimens, in counterpart; Boll, Würtemberg. Several of the head-bones are well shown. *Purchased*, 1845.

22529, –a. One contorted fish and two imperfect specimens, the first from Boll, the others probably from Ohmden, Würtemberg. *Purchased*, 1848.

36129. Fish about 0·09 in length, crushed and distorted anteriorly, and displaying the broad hæmal spines at the base of the caudal fin; Metzingen, Würtemberg. *Purchased*, 1861.

P. 945, P. 950. Eight specimens, variously imperfect, two exhibiting the general form of the trunk and the position of the fins; Ohmden. *Egerton Coll.*

P. 3663, P. 3665. Fish about 0·09 in length, and a smaller fragmentary specimen; Ohmden. *Enniskillen Coll.*

P. 946. Fish wanting caudal region, labelled *Leptolepis jaegeri* by Count Münster; Ohmden. *Egerton Coll.*

32453–63, 32465–71, 32583. Series of eighteen specimens, one being in counterpart, illustrating all the principal features in the skeleton of this species; Curcy, Normandy. *Tesson Coll.*

P. 947–8. Six similar specimens; Curcy. *Egerton Coll.*

28855. Three imperfect fishes, two being in counterpart, and also one head; Alderton, near Cheltenham. *Purchased*, 1854.

P. 3667. Contorted fish; Ilminster, Somersetshire. *Enniskillen Coll.*

32583 a, b. Two very small specimens (one being in counterpart) with relatively large head, probably to be regarded as young of this species; Curcy. *Tesson Coll.*

The following specimens of *Leptolepis* from the Upper Lias of Dumbleton, Gloucestershire, represent the form named *L. concentricus* by Egerton (Quart. Journ. Geol. Soc. vol. v. 1849, p. 35, and Figs. & Descript. Brit. Organic Remains, dec. vi. 1852, no. 9). This is said to be distinguished from the so-called *L. constrictus* (identified above with *L. bronni*) by its relatively larger head, thicker scales, and smooth preoperculum; but, judging from present evidence, it seems likely that all these differences will prove to be merely due to differences in the state of preservation. The type specimen is in the Collection of Rev. P. B. Brodie, Rowington.

P. 940. Imperfect fish and six fragments, labelled *Leptolepis concentricus* in Egerton's handwriting. The preoperculum in the best specimen is smooth, but probably does not exhibit the outer layer, and the corresponding bone in two of the fragments shows distinct indications of the superficial radiating ridges. *Egerton Coll.*

39150–52. Three imperfect specimens. *Bowerbank Coll.*

P. 3666. Five similar specimens, two exhibiting traces of the radiating ridges on the operculum. *Enniskillen Coll.*

P. 6145. Greater portion of fish and a detached head. *Purchased*, 1890.

P. 7038. Seven fragmentary specimens, one being in counterpart, exhibiting the form of various bones. *Purchased*, 1894.

Leptolepis saltviciensis, Simpson.

(?) 1844. *Leptolepis filipennis*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 134. [Imperfect fish; British Museum.]

1855. *Saltviciensis*, M. Simpson, Foss. Yorkshire Lias, p. 19.

P. 7038. Two show well-ossified occiput.

1895. *Leptolepis saltvicensis*, A. S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii. p. 26, pl. iii. figs. 1–5.

P. 4369. Des? & fig? loc. cit. 1895, p. 28, pl. iii. fig. 2.

P. 951. Des? & fig? loc. cit. 1895, p. 27, pl. iii. fig. 1.

P. 512. Des? & fig? loc. cit. 1895, p. 29, pl. iii. fig. 4.

41724. Des? & fig? loc. cit. 1895, p. 29, pl. iii. fig. 5.

P. 938. Two des? & fig? loc. cit. 1895, p. 29, pl iii. fig. 3.

1876. *Leptolepis saltviciensis*, J. F. Blake, in Tate & Blake, Yorkshire Lias, p. 260, pl. iii. fig. 1.
1884. *Leptolepis saltviciensis*, M. Simpson, *op. cit.* ed. 2, p. 16.

Type. Nearly complete fish ; Whitby Museum.

A small species closely related to *L. bronni*, apparently only differing from the latter in the comparatively less deepened form of the abdominal region and in the greater tenuity of the skeleton.

Form. & Loc. Upper Lias : Yorkshire.

P. 4369, P. 3668. Fine specimen about 0·085 in length, and three smaller specimens ; Whitby. *Enniskillen Coll.*

P. 951, P. 351. A small fish exhibiting all the fins, and two other specimens ; Whitby. *Egerton Coll.*

P. 512. Imperfect contorted fish, 0·065 in length, in similar matrix to the above, but labelled "Street" by Agassiz and Egerton ; intended to be the type specimen of the undefined *Leptolepis filipennis*, Ag. *Egerton Coll.*

41724. Fish in counterpart, displaying the caudal vertebræ ; Whitby. *Toulmin Smith Coll.*

P. 7586. Another specimen, exhibiting the caudal vertebræ and paired fins ; Whitby. *History unknown.*

36017, 36316. Slab with two fishes and another specimen ; Whitby. *Purchased*, 1851, 1860.

P. 938. Three imperfect much crushed and distorted specimens, labelled "*Leptolepis filipennis* ?" by Egerton, doubtfully ascribed to this species ; Whitby. The squamation is not shown as in the specimens mentioned above, and the vertebræ are so much crushed that they have the appearance of being relatively deeper. *Egerton Coll.*

Leptolepis jaegeri, Agassiz.

1832. *Leptolepis jaegeri*, L. Agassiz, Neues Jahrb. p. 146.
1832. *Leptolepis longus*, L. Agassiz, *ibid.* p. 146.
1844. *Leptolepis jaegeri*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 133.
1844. *Leptolepis longus*, L. Agassiz, *ibid.* p. 133.

Type. Nearly complete fish.

A species slightly exceeding the type in size, and with very delicate skeleton. Head with opercular apparatus occupying nearly one-fifth of the total length of the fish ; caudal pedicle compara-

tively robust. Vertebral centra in the form of thin cylinders, not much constricted and none much longer than deep. Fins as in the type species.

Form. & Loc. Upper Lias: Würtemberg.

19637–40. Three specimens, one being in counterpart and the largest about 0·12 in length; Boll. In the third specimen the head is elongated by crushing and displays several of the bones. *Purchased*, 1845.

Leptolepis autissiodorensis, Sauvage.

1892. *Leptolepis autissiodorensis*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. v. p. 393, pl. xvi. fig. 2 (reprinted in Bull. Soc. Sci. Yonne, vol. xlvii. 1893, p. 28, pl. i. fig. 2).

Type. Nearly complete fish.

A robust species attaining a length of about 0·1. Length of head with opercular apparatus about equalling the maximum depth of the trunk and contained about four-and-a-half times in the total length of the fish; width of caudal pedicle equalling one-quarter the maximum depth of the abdominal region. Vertebræ and fins as in the type species.

Form. & Loc. Upper Lias: Yonne, France.

Not represented in the Collection.

Leptolepis talbragarensis, A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9, with drawings on pl. vi. figs. 1–8.]

Type. Nearly complete fish; Geol. Survey Museum, Sydney.

A robust species ordinarily attaining a length not exceeding 0·15. Length of head with opercular apparatus less than the maximum depth of the trunk, and somewhat less than one-fifth of the total length of the fish; caudal pedicle robust, nearly half as deep as the abdominal region. Vertebræ about 45 in number, the centra scarcely longer than deep in the anterior part of the caudal region, and forming thin, smooth constricted cylinders; the neural and hæmal arches in the anterior part of the caudal region gently arcuated, not depressed. Pelvic fins arising slightly nearer to the anal than to the pectorals; dorsal with about 12 rays, arising in advance of the middle point of the back and immediately behind the origin of the pelvic fins; anal fin with about 9 rays, arising midway between the pelvic and caudal fins.

Form. & Loc. Upper Hawkesbury-Wianamatta Series: Talbragar, New South Wales.

Not represented in the Collection.

1935. L. a. C. Chamberlain, p. 25, pl. ii, f. 4, 7.
1952. L. antisiodorensis (nec) B. Hauf, Das Höh med. Zucht, p. 26 pl. 59 f. c.

Syn. L. L. R.T. Wade, J. Proc. R.S. N.S.W. 75 p. 834-8.

Leptolepis lowei, A. S. Woodward.

[Described in forthcoming Mem. Geol. Surv. N. S. Wales, Palæont. no. 9, with drawings on pl. vi. figs. 9, 10.]

Type. Nearly complete fish; Geol. Survey Museum, Sydney.

A more slender and smaller species than the preceding, closely resembling this, but with a more elongated head of which the length is about equal to the maximum depth of the trunk.

Form. & Loc. Upper Hawkesbury-Wianamatta Series: Talbragar, New South Wales.

Not represented in the Collection.

Small fishes which may be either the fry of the last species or a distinct and diminutive species are provisionally named *L. gregarius*, A. S. Woodward, *loc. cit.* pl. iv. figs. 8–10, pl. v. fig. 5, pl. vi. figs. 11, 12.

Leptolepis disjectus, A. S. Woodward.

1890. *Leptolepis disjectus*, A. S. Woodward, Proc. Geol. Assoc. vol. xi. p. 295, pl. iii. figs. 16–19.

Type. Detached bones; British Museum.

An indefinable provisional name applied to the only known remains of *Leptolepis* from the Lower Oolites. The maxilla is very slightly rugose near its oral margin; the preoperculum is sharply bent, while the radiating markings are almost or completely confined to its lower limb; the operculum is smooth and about two-thirds as broad as deep.

Form. & Loc. Bathonian: Oxfordshire.

All the following specimens were obtained from the Stonesfield Slate, Stonesfield, near Oxford:—

P. 959. Detached maxilla, dentary, operculum, and preoperculum, being the type specimens figured *loc. cit.* *Egerton Coll.*

P. 958 a, P. 959 a. Two examples of the cranial roof, one being in counterpart and labelled "*Belonostomus leptosteus*, Agass." by Agassiz. *Egerton Coll.*

P. 959 b, P. 3797, P. 4277 a. Seven maxillæ. *Egerton & Enniskillen Colls.*

P. 959 c, P. 3793. Seven dentaries. *Egerton & Enniskillen Colls.*

P. 959 d, P. 3798. Ten ceratohyals. *Egerton & Enniskillen Colls.*

P. 959 e. Anterior suborbital. *Egerton Coll.*

P. 959 f, P. 3796 a. Six preopercula. *Egerton & Enniskillen Colls.*

Leptolepis macrophthalmus, Egerton.

[Plate XVIII. fig. 3.]

1845. *Leptolepis macrophthalmus*, Sir P. Egerton, Quart. Journ. Geol. Soc. vol. i. p. 231.

1852. *Leptolepis macrophthalmus*, Sir P. Egerton, Figs. & Descript. Brit. Organic Remains, dec. vi. (Mem. Geol. Surv.), no. 8, pl. viii.

Type. Imperfect fishes; British Museum.

A large and comparatively slender species, attaining a length of about 0·24. Length of head with opercular apparatus much exceeding the maximum depth of the trunk and contained little more than four times in the total length of the fish; width of caudal pedicle equalling nearly one-half of the maximum depth of the abdominal region. Vertebræ and fins apparently as in *L. dubius*.

Form. & Loc. Oxfordian: Wiltshire.

All the following specimens were obtained from Christian Malford, near Chippenham:—

P. 575, P. 576, P. 3677. Three specimens described and figured by Egerton, *loc. cit.* 1852, to be regarded as the type specimens. The original of fig. 2, *loc. cit.*, is a nearly complete fish 0·13 in length, while the original of fig. 3 is very imperfect and wants the caudal region.
Egerton & Enniskillen Colls.

46344. Fine specimen 0·235 in length showing the axial skeleton, the abdominal vertebræ apparently with broad transverse processes by which the delicate ribs are supported (Pl. XVIII. fig. 3). *Cunnington Coll.*

20090. Ten imperfect fishes, variously preserved, and one head with opercular apparatus and pectoral fin. The radiating markings on the preoperculum are confined to its lower limb and are fine and numerous. *Purchased*, 1846.

19959. Small fish, with imperfect head and tail. *Purchased*, 1846.

21435. Small specimen displaying the paired fins, the pectoral with not less than 16, the pelvic with not less than 9 rays. The latter are more than two-thirds as long as the former.
Purchased, 1847.

24676, 26470. Two large and two small specimens. The pelvic fin-supports are exhibited. *Purchased*, 1850–51.

P. 936, P. 5145–46. One large fragment and seven small specimens more or less imperfect. *Egerton Coll.*

1903. Lepidolepis knorrii, L. Coulon, Bull. Soc. Étude Sci. Nat. Elbeuf, 28th. year 1902, p. 155, fig. 1.

1914. Lepidolepis dubia, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 386, pl. 71. fig. 1. [From Cirin, Ain, France.]

1925. Lepidolepis dubius, T. D. A. Cockerell, Bull. Am. Mus. N.H., vol. li, Art. viii. p. 314 pl. 3 figs. 3. [Scales].

1939. L. ? d. N. Rolfsgaard de Saez Notas Mus. La Plata 4 Pal p. 431 figs (? U. Sus. Argentine).

1946. = adult Sphaleriformis see p. 513

1961. L. dubia O. Nybelin Pal Zeit. 35:118 pls. 11-13. Part Skull.

P. 937. More fragmentary specimen labelled "*Leptolepis costalis*" by Egerton. *Egerton Coll.*

P. 4364. Three imperfect specimens, one indicating a very large fish. *Enniskillen Coll.*

Leptolepis dubius (Blainville).

[Plate XIV. figs. 6, 7.]

1755. Figures by G. W. Knorr, Samml. Merkwürdigk. Natur, pls. xxiv., xxvii.

1818. *Clupea dubia*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 331.

1826. *Ichthyolithus esociformis*, E. F. Germar, Keferstein's Teutschland geogn. dargestellt, vol. iv. p. 96.

(?) 1826. *Ichthyolithus luciiformis*, E. F. Germar, *ibid.* p. 96, pl. i. *a.* fig. 1.

(?) 1826. *Esox avirostris*, E. F. Germar, *ibid.* p. 95, pl. i. *a.* fig. 2.

1833–44. *Leptolepis knorrii*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 13; pt. ii. pp. 134, 294 (in part).

1833–44. *Leptolepis dubius*, L. Agassiz, *ibid.* pt. i. p. 13; pt. ii. pp. 134, 294.

(?) 1848. *Tharsis germari*, C. G. Giebel, Fauna d. Vorw., Fische, p. 146. [Nearly complete fish; Halle Museum.]

(?) 1848. *Tharsis elongatus*, C. G. Giebel, *ibid.* p. 147. [Ditto.]

(?) 1848. *Tharsis intermedius*, C. G. Giebel, *ibid.* p. 147. [Ditto.]

1861. *Leptolepis clupeiformis*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 9, fig. 1. [Nearly complete fish; Teyler Museum, Haarlem.]

1863. *Leptolepis knorrii*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 740.

1888. *Leptolepis knorri*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 271, fig. 277.

Type. Nearly complete fish; Museum of Natural History, Paris.

A large and robust species, attaining a length of about 0·3. Length of head with opercular apparatus about equal to the maximum depth of the trunk and one-fifth of the total length of the fish; caudal pedicle comparatively narrow, its depth not exceeding one-third the maximum depth of the abdominal region. Vertebræ about 50 in number, the centra at least as long as deep and slightly strengthened by the addition of small longitudinal ridges of secondary bone; neural and hæmal spines in caudal region much inclined. Pelvic fins arising much nearer to the anal than to the pectorals, and comprising not less than 12 rays; dorsal with about 15 rays, arising slightly in advance of the pelvic pair and not extending so far as a point opposite the comparatively small anal, which comprises only about 10 delicate and closely-arranged rays;

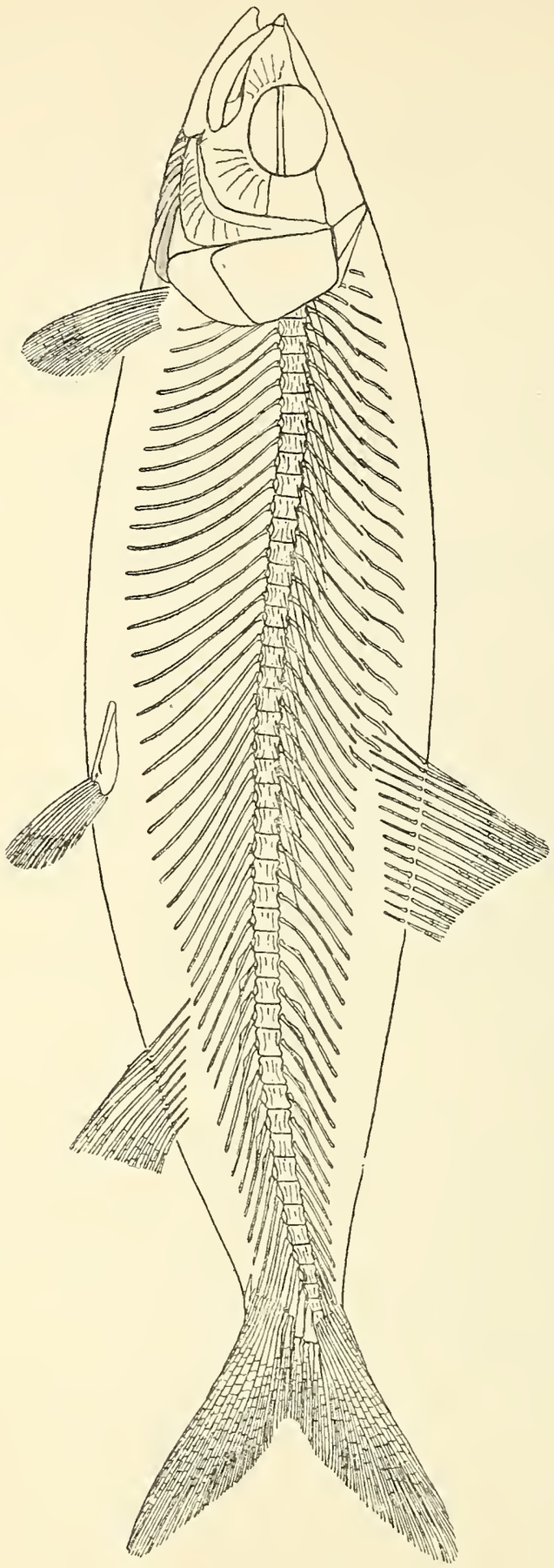

Fig. 45.

Leptolepis dubius; restoration, scales omitted.

37821,-25,-32 show well-preserved scales with pectinate markings, very fine & delicate.

P. 924. Arc. Dors. Scales ƒ[—x.] fig. Cockerell 1925. Wr. cit

P. 3674 shows large bony gill-rakers among the scattered remains of the gill-arches. See A.S. Woodward, Fos. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 131.

anal arising midway between the pelvic fins and the caudal, or slightly nearest to the former.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

19824. Small fish about 0·155 in length; Solenhofen.
Presented by Mr. Heuland, 1845.

22507, 22511, 22520. Three specimens, the first wanting the tail, the second much contorted, and the third wanting the dorsal, anal, and pelvic fins; Solenhofen. *Purchased*, 1848.

32479. Axial skeleton of a fish 0·28 in length; Solenhofen.
Tesson Coll.

36025. A typical specimen, chiefly in impression; Solenhofen.
Purchased, 1861.

37072, 37074, 37075, 37079, 37084, 37087, 37092, 37096, 37103, 37820–25, 37827, 37830–32, 37847–49, 37851–54, 37857, 37858, 37861, 37863, 37866, 37872, 37932. Series of thirty-three specimens, some in counterpart, exhibiting all the principal characters of the genus and species; Solenhofen. *Häberlein Coll.*

37868. Imperfect specimen displaying the vertebral centra and indicating the extent of the persistence of the notochord; Solenhofen. *Häberlein Coll.*

37839. Imperfect skeleton displaying the tail as shown of the natural size in Pl. XIV. fig. 7; Solenhofen. *Häberlein Coll.*

37049, 37859–60, 37874. Four small specimens exhibiting the axial skeleton; Solenhofen. *Häberlein Coll.*

P. 924. Five typical specimens; Solenhofen. *Egerton Coll.*

P. 924 a. Fragmentary specimen; Daiting. *Egerton Coll.*

P. 927. Axial skeleton with paired and caudal fins; Pointen.
Egerton Coll.

P. 3672, P. 4360. Three specimens; Solenhofen. *Enniskillen Coll.*

P. 3674. Imperfect fish probably of this species, labelled "*Leptolepis latus*, Agass.," apparently in the handwriting of Count Münster; Eichstädt. *Enniskillen Coll.*

37839 a. Remains of head and opercular apparatus probably of this species, shown of the natural size in Pl. XIV. fig. 6; Solenhofen. The parts are indicated by the lettering.
Häberlein Coll.

Leptolepis voithi, Agassiz.

(?) 1839. *Ascalabos voithii,* G. von Münster, Beitr. Petrefakt. pt. i. p. 112, pl. xii. fig. 5.
1844. *Leptolepis voithii,* L. Agassiz, Poiss. Foss. vol. ii. pt. ii. pp. 131, 295, pl. lxi. *a.* figs. 2–4.
1844. *Leptolepis contractus,* L. Agassiz, *ibid.* pt. ii. pp. 134, 294.
1844. *Leptolepis polyspondylus,* L. Agassiz, *ibid.* p. 133, pl. lxi. figs. 7, 8. [Immature fish.]
1844. *Leptolepis paucispondylus,* L. Agassiz, *ibid.* p. 134 (name only).
(?) 1848. *Tharsis radiatus,* C. G. Giebel, Fauna d. Vorw., Fische, p. 146. [Nearly complete fish; Halle Museum.]
1863. *Leptolepis voithii,* A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. pp. 741, 744.

Type. Nearly complete fishes; Palæontological Museum, Munich.

A small species, attaining a length of about 0·12. Length of head with opercular apparatus considerably exceeding the maximum depth of the trunk, and equalling about one-quarter of the total length of the fish; caudal pedicle comparatively robust, its depth exceeding one-third the maximum depth of the abdominal region. Vertebræ about 35 to 40 in number, the centra in the caudal region longer than deep and all comparatively robust, being strengthened by the addition of small longitudinal ridges of secondary bone; neural and hæmal spines in the anterior part of the caudal region gently arcuated. Pelvic fins arising much nearer to the anal than to the pectorals; dorsal with about 14 rays, arising opposite the pelvic pair and extending almost as far as a point opposite the anal, which comprises about 10 rays and arises much nearer to the pelvic fins than to the caudal.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37059, 37062, 37064, 37077, 37080, 37900, 37908–10, 37916–18, 37921. Thirteen specimens, three being in counterpart, variously preserved and exhibiting all the principal characters of the species; Solenhofen. *Häberlein Coll.*

P. 931, P. 3672. Fine specimen 0·085 in length, in counterpart; Solenhofen. *Egerton & Enniskillen Colls.*

P. 3673. Two large contorted specimens, probably of this species; Kelheim. *Enniskillen Coll.*

P. 3673 a. Typical well-preserved fish 0·075 in length; Kelheim. *Enniskillen Coll.*

46315. Similar specimen; Kelheim. *History unknown.*

[?] 1903. *Leptolepis voithi*, H. E. Sauvage, Mem. R. Acad. Ciencias Barcelona [3] vol. iv. no. 35, p. 13, pl. iv. fig. 5. [Montsech, Lérida.]

[?] 1912. *Leptolepis* aff. *voithi*, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. x]. [3] vol. xvii. p. 231, pl. iv. figs. 4, 5. [Cenomanian, Castellammare, Naples.]

1951. *L. voithi* L. F. Conrad Not. Com. Inst. geol. España 23 p. 7, pl. i f. 1. (U. Jur. Spain).

1969. *L. v.* P. de Saint-Seine N. Arch. Mus. H. N. Lyon 2 p. 239, pl. xxiii f. c.

1903. Leptolepis sprattiformis, L. Coulon, Bull. Soc. Etude Sci. Nat. Elbeuf, 2nd. year 1902, p. 155, fig. 3.

1914. Leptolepis sprattiformis, C. R. Eastman, Mem. Carnegie Mus. vol. VI. p. 422, pl. 7 xxiii. figs. 1, 2.

(?) 1922. Leptolepis aff. sprattiformis, G. D'Erasmo, Rend. R. Accad. Sci. Napoli, no. , p. 8, pl. i. fig. 2. [Cretaceous; Roccadevandro, Prov. Caserta.]

1936. Leptolepis, Cleveman, p. 218, pl. 1.

1949. L. S. incl. L. dubrisi P. de Saint-Seine, N. Prob. Mus. H.N. Lyon 2 p. 225 ff. 88-106.

1958. L. S. O. Nybelin Ark. Zool (2) 11. 28: 446 ff. 4, 9.

P. 930. Smaller specimen, wanting the greater part of the head, labelled "*Leptolepis paucispondylus*" by Münster; Kelheim. *Egerton Coll.*

22519. Imperfect small fish 0·055 in length; Solenhofen. *Purchased*, 1848.

37063. Two more immature specimens; Solenhofen. *Häberlein Coll.*

P. 934. Immature fish, somewhat contorted, probably of this species; Pointen. *Egerton Coll.*

37063, 37894, 37891, 37896. Four immature fishes with incomplete vertebral centra, probably of this species; Solenhofen. *Häberlein Coll.*

P. 3671. Similar specimen, labelled "*Leptolepis polyspondylus*" by Münster; Pointen. *Enniskillen Coll.*

P. 935. Another immature fish; Kelheim. *Egerton Coll.*

Leptolepis sprattiformis (Blainville).

1755. Figures by G. W. Knorr, Samml. Merkwürdigk. Natur, pl. xxiii. figs. 2, 3, pl. xxviii. fig. 3, pl. xxix. figs. 2–4.

1818. *Clupea sprattiformis*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 330.

(?) 1839. *Leptolepis pusillus*, G. von Münster, Neues Jahrb. p. 680. [Immature fish; Palæontological Museum, Munich.]

1833–44. *Leptolepis sprattiformis*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 13; pt. ii. pp. 130, 294, pl. lxi. *a*. fig. 1.

1839–44. *Leptolepis macrolepidotus*, L. Agassiz, *ibid.* pt. ii. p. 132, pl. lxi. figs. 4–6. [Immature fish.]

1863. *Leptolepis sprattiformis*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. pp. 741, 744.

1888. *Leptolepis sprattiformis*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 272, fig. 279.

Type. Nearly complete fish; Museum of Natural History, Paris.

A small, slender species, attaining a length of about 0·11, but usually less. Length of head with opercular apparatus considerably exceeding the maximum depth of the trunk, and equalling about one-quarter of the total length of the fish; caudal pedicle comparatively robust, its depth about half the maximum depth of the abdominal region. Vertebræ about 50 in number, the centra short and stout, and the neural and hæmal spines in the anterior part of the caudal region gently arcuated. Pelvic fins arising much nearer to the anal than to the pectorals; dorsal with about 14 rays, arising

opposite the origin of the pelvic pair, and not extending so far as a point opposite the comparatively small anal, which is nearer to the caudal than to the pelvic fins.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone); Bavaria.

37923. Fine specimen about 0·113 in length; Solenhofen. *Häberlein Coll.*

P. 7587. Four distorted specimens, and a slab with two similar fishes; Eichstädt and Pappenheim.

22521–23. Two typical specimens and one very small fish; Solenhofen. *Purchased*, 1848.

36022, 36024. Imperfect fish 0·085 in length and two smaller specimens; Solenhofen. *Purchased*, 1861.

37054, 37057, 37877–80, 37882–85, 37912. Eight small specimens, and three slabs with more than one fish; Solenhofen. *Häberlein Coll.*

43464. Small slab with various remains and an isolated specimen; Solenhofen. *Presented by Kenneth Murchison, Esq.*, 1872.

P. 263. Slab with three fine fishes; Solenhofen. *Purchased*, 1880.

P. 7588. Fish 0·07 in length associated with another fragment; Solenhofen. *History unknown.*

P. 926, P. 932 a. Four specimens, the last labelled "*Leptolepis pusillus*" by Münster; Solenhofen and Kelheim. *Egerton Coll.*

P. 3669 a, P. 4359, P. 4361–62, P. 4363 a. Slab with seven specimens, labelled by Agassiz, and four imperfect fishes, the second labelled "*Leptolepis pusillus*" by Münster; Solenhofen and Kelheim. *Enniskillen Coll.*

P. 4996–97. Slab with five fishes, and an isolated specimen; Solenhofen. *Presented by J. E. Lee, Esq.*, 1885.

22506. Three small fishes, two being on one slab; Solenhofen. *Purchased*, 1848.

21529. Fish 0·047 in length; Solenhofen. *Purchased*, 1847.

P. 7589. Fry apparently of this species; Eichstädt.

Clupavus yamangiensis s.n. L. Cret. Congo, P. Casier, 1961 Ann. Mus. r. Afr. Centr. 39: 54 pl. vii f. 1, viii. f. 1. Fish: Teleosts.

Clupavus longicaudatus s.n. L. Cret. Congo, P. Casier, 1961. Ann. Mus. r. Afr. Centr. 39: 57 pl. viii f. 2-3, viii f. 2, ix. Sup fish. Teleosts.

Clupavus gen. nov. type L. brodiei mihi. fossus, neocomiensis, neumayri, engelensis Arambourg 1952 C.R. Acad Sci. Paris p. 416, ff.

Paraclupavus gen nov. type P. caheni sp nov., U. Jurassic, Congo, 1962 P. Saint-Seine & P. Casier, Ann. Mus r. Afr. Centr., 8°, Sci Géol, no 44 p. 30, pls 8, 9; t-fs 10-17. Type sup. fish, Teleosts.

1912. Leptolepis brodiei, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. [3] vol. xvii. p. 229, pl. iv. f. 6.

1915. Leptolepis brodiei, G. D'Erasmo, Palaeont. Italica, vol. xxi. p. 12, pl. i. figs. 4-6

1919. Leptolepis brodiei, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. (Pal. Soc. 1917). p. 122, pl. xxiii. figs. 1-6.

1946. L. neocomiensis D'Erasmo p. 33 pl. i f. a
" " brodiei " 35 — 10.

1955. Clupavus neocomiensis C. Arambourg, Not. Mem. Serv. g Maroc 118 p. 25. ff. 14-21 pls iii, iv. Cenomanian Morocco

P.7635. Type specimen, des? & fig? A.S.W. 1919, p. 123, pl. xxiii. fig. 3; Dinton. P.B. Brodie Coll.

P.7635a. Specimen fig? by Brodie 1845, pl. i. fig. 3, and A.S.W. 1919, p. 123, pl xxiii. fig. 4; Dinton. P.B. Brodie Coll.

P.7635b. Another specimen, frontals noticed A.S.W. 1919, p. 123; Dinton. P.B. Brodie Coll.

P.7636. Three specimens; Dinton. P.B. Brodie Coll.

37055, 37071, 37892–93, 37895, 37897–98. Fry probably for the most part of this species; Solenhofen. *Häberlein Coll.*

P. 928–29, P. 932. Similar fry, some with incompletely formed vertebral centra; Kelheim and Solenhofen.

Egerton Coll.

P. 3669–70. Three similar specimens; Kelheim and Solenhofen.

Enniskillen Coll.

Clupavus

Leptolepis brodiei, Agassiz.

1845. *Leptolepis brodiei*, L. Agassiz, in P. B. Brodie, Foss. Insects, p. 15, pl. i. figs. 1, 3.

1850. *Sarginites pygmæus*, O. G. Costa, Atti Accad. Pontan. vol. v. p. 285, pl. vi. figs. 6–8. [Imperfect fishes; Geological Museum, University of Naples.]

1850. *Megastoma apenninum*, O. G. Costa, *ibid.* p. 287, pl. vi. figs. 9, 10. [Ditto.]

1853. *Sarginites pygmæus*, O. G. Costa, *loc. cit.* vol. vii. p. 7, pl. i. fig. 4.

1853. *Megastoma apenninum*, O. G. Costa, *ibid.* p. 8, pl. i. fig. 3.

1879. *Leptolepis neocomiensis*, F. Bassani, Verhandl. k. k. geol. Reichsanst. p. 164. [Imperfect fish; Imperial Geological Survey Museum, Vienna.]

1882. *Leptolepis neocomiensis*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 204, pl. ii. figs. 1–5.

1895. *Leptolepis brodiei*, A. S. Woodward, Geol. Mag. [4] vol. ii. p. 150, pl. vii. figs. 5, 6.

Type. Imperfect fish; collection of Rev. P. B. Brodie.

A small species attaining a length of about 0·05. Length of head with opercular apparatus exceeding the maximum depth of the trunk and contained about four times in the total length of the fish; width of caudal pedicle exceeding half the maximum depth of the abdominal region. Vertebræ about 40 in number, the centra robust and as deep as long, the neural and hæmal spines in the caudal region straight and gently inclined. Pelvic fins arising about midway between the anal and pectoral fins, opposite to the origin of the dorsal, which has 12 rays; anal fin with about 7 rays, arising much nearer to the caudal than to the pelvic fins.

Form. & Loc. Lower Purbeckian: Vale of Wardour, Wiltshire. Upper Jurassic: Naples. Cretaceous: Istria and Dalmatia.

P. 3675–a. Contorted fish, and a very small specimen with remarkably large head; Lower Purbeck, Vale of Wardour.

Enniskillen Coll.

P. 941. Imperfect fish originally about 0·027 in length; Vale of Wardour. *Egerton Coll.*

P. 4729. Another diminutive specimen; Vale of Wardour. *Presented by Rev. P. B. Brodie*, 1885.

P. 3612. Imperfect fish 0·05 in length, of the form named *L. neocomiensis* by Bassani; Upper Jurassic, Torre d'Orlando, Castellamare, Naples. *Enniskillen Coll.*

The fry of *Leptolepis* from the Purbeck Beds of the Vale of Wardour bearing the undefined name of *L. nanus* (Egerton, in Brodie's Foss. Insects, 1845, p. 15, pl. i. fig. 5) is insufficient for specific determination and quite possibly belongs to *L. brodiei*. The following specimen represents the immature fish:—

P. 942. Specimen 0·004 in length, labelled by Egerton; Lower Purbeckian, Vale of Wardour. *Egerton Coll.*

= Clupavus see p. 515. Leptosomus **Leptolepis neumayri**, (Bassani) See vol. IV p. 245

1879. *Leptolepis neumayri*, F. Bassani, Verhandl. k. k. geol. Reichsanst. p. 164.

1882. *Leptolepis neumayri*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 206, pl. ii. figs. 6–10.

Type. Nearly complete fish; Imperial Geological Survey Museum, Vienna.

A small stout species attaining a length of about 0·05. Length of head with opercular apparatus slightly less than the maximum depth of the trunk and contained scarcely more than four times in the total length of the fish; width of the caudal pedicle not exceeding one-third of the maximum depth of the abdominal region. Vertebræ less than 40 in number. Pelvic fins arising opposite the origin of the dorsal, which has 14 rays; anal fin with about 12 rays, very slightly nearer to the caudal than to the pelvic fins.

The enlarged sketch of the jaws published by Bassani seems to the present writer to be a misleading interpretation of obscure specimens.

Form. & Loc. Cretaceous: Island of Lesina, Dalmatia.

Not represented in the Collection.

The following specimens of *Leptolepis* are not specifically determined:—

P. 6520. Remains of trunk; Oxford Clay, near Weymouth. *Presented by Rev. G. E. Rogers*, 1891.

P.6305. Group of small fishes, maxillary teeth noticed A.S.W. 1919, p. 123; Jeffont.
Pres? Rev. W. R. Andrews, 1890.

P.9847-49. Two trunks des? & fig? by A.S.W. 1895, p. 150, pl. vii. figs. 5, 6, and A.S.W. 1919, p. 123, pl. xxiii. figs. 5, 6; Jeffont. Pres? Rev. W. R. Andrews, 1903.

P.7637. Type specimen of Leptolepis nanus des? & fig? A.S.W. 1919, p. 125, pl. xxiii. fig. 2; Sinton.
P. B. Brodie Coll.

P.7638. Another specimen labelled L. nanus by Brodie; Sinton. P. B. Brodie Coll.

Sp. indet.

P.11904. Right dentary des? & fig? A.S.W. 1919, p. 125, pl. xxiii. fig. 7; Wadhurst Clay, Broad Oaks, Brede, Hastings. Pres? Revs. P. Teilhard & F. Pelletier, S.J., 1912.

Leptolepis valdensis, A.S. Woodw.

1907. Leptolepis valdensis, A. S. Woodward, Ann. Mag. Nat. Hist. [7] vol. xx. p. 93, pl. i.
Type. Imperfect fish; British Museum.
Form. & Loc. Wealden: Sussex.

P.10440. Type specimen, lacking anterior part of head & hinder half of caudal fin, des? & fig? loc. cit.; Weald Clay, Southwater, Sussex.
Pres? by Southwater Brick & Tile Co., Ltd?, 1907.
Named Aethalion valdensis, A.S. Woodward, Foss. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 126, text-fig. 39.

966 Aethalionopsis valdensis (Woodward), J. Gaudant, C.R. Soc. géol. Fr, 1966, 8: 309

Leptolepis (?) sp., G. De Alessandri, Mem. Soc. Ital. Sci. Nat. vol. vii (1910), p. 144, pl. ix. fig. 11. — Upper Trias; Perledo, Como. [Mus. Civ. Milan.] Also Deecke 1889 Palaeont. 35: 126, pl. 7, fig. 4

Leptolepis congolensis, s.n. Aramborg & Johnels Ann. Mus. 1936, p. 13. 17. pl. 6

L. Cretacea: Galoon. Zitt. M.H.N. Paris. (see p. 515)

Leptolepis attenuatus, R. H. Traquair, Poiss. Weald. Bernissart (Mém. Mus. Roy. Hist. Nat. Belg. vol. vi 1911), p. 58, pl. xii. figs. 5, 6, text-fig. 22. — Wealden; Bernissart, Belgium. [Imperfect fish; Mus. Brussels.]

Leptolepis brevis, R. H. Traquair, loc. cit. 1911, p. 59, pl. xii. figs. 7, 8, text-fig. 23. — Ibid. [Ditto.]

Leptolepis formosus, R. H. Traquair, loc. cit. 1911, p. 56. pl. xii. figs. 1–4, text-fig. 21. Ibid. [Ditto.] (see p. 515).

Leptolepis rathorsti, A. S. Woodward, Bihang t. Svensk. Vet.-Akad. Handl. vol. xxv. sect. iv. no. 5 (1900), p. 4, figs. 2–11. — U. Jurassic; Swedish Foreland, King Charles Land. [Fragments; State Mus., Stockholm.]

Leptolepis crassicauda, J. S. Hall, Proc. Roy. Soc. Victoria, n.s. vol. xii (1900), p. 149, pl. xiv. fig. 2. — Mesozoic; Casterton, Victoria, Australia. [Imperfect trunk; Ballarat School of Mines.]

Leptolepis? chiesai, s.n., A. Bosi 1940, Riv. Ital. Paleont. xl vi, p. 17, 17. 1. pl. [illegible]

Oxyporius tenuis = immature Leptolepis brodiei, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 125, pl. xxiii. fig. 1.

P. 7634. Counterpart of P. 923, dentary noticed A. S. W. 1919, p. 125; also another fish; Dinton. P. B. Brodie Coll.

P. 4730 is the type specimen, re-figured by A. S. W. 1919, op. cit. p. 125, pl. xxiii, fig. 1.

P. 7633. Two fishes on one slab; Dinton. P. B. Brodie Coll.

Leptolepis longicephalus ? s.n. T. Takai, 1941 J. G. Soc. Jo, 44 48 : 362 (in Jap.) see IV p. 1a

P. 6736. Preoperculum ; Oxford Clay. *Jesson Coll.*

P. 4696. Three small fishes, the largest 0·08 in length ; Lower Kimmeridgian (Lithographic Stone), Cirin, Ain, France. The best specimen shows impressions of about 45 vertebral centra, and the head with opercular apparatus is contained four times in the total length of the fisn.

Purchased, 1884.

The following species are incompletely defined or unrecognizable, and the third is clearly not represented in the Collection :—

Leptolepis grandis, T. C. Winkler, Archiv. Mus. Teyler, vol. iii. (1871), p. 183, pl. v. figs. 13, 14.—Lower Kimmeridgian (Lithographic Stone) ; Bavaria. [Scales : Teyler Museum, Haarlem.]

Leptolepis latus, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. (1844), pp. 134, 295 (name only).—Ibid. [Unknown.]

Leptolepis matronensis, F. J. Pictet, Mém. Soc. Linn. Normandie, vol. xvi. (1872), no. i. p. 13, pl. ii. fig. 1.—Portlandian ; Beaudrecourt, Haute Marne. [Royer Collection.]

Leptolepis tenellus, L. Agassiz, *tom. cit.* (1833–44), pt. i. p. 13 ; pt. ii. p. 134.—Lias ; Baden. [Imperfect fish.]

L. checchiai s.n. U. Cret. Caso Trentino. D'Erasmo 1946 p. 37 fig. 12. pl. I f. 2. (rest.).

Undetermined immature examples of *Leptolepis* from the Bavarian Lithographic Stone seem to have been named *Tharsis parvus* and *Tharsis microcephalus* by C. G. Giebel, Fauna d. Vorw., Fische, (1848), p. 147.

The undefined generic name *Oxygonius* (L. Agassiz, in Brodie's Fossil Insects, 1845, p. 16) is given to some indeterminable fry from the Purbeck Beds of the Vale of Wardour which cannot be satisfactorily distinguished from *Leptolepis*. The typical and only known species is *O. tenuis* (L. Agassiz, *op. cit.* p. 16, pl. i. fig. 4), and it is represented in the Collection by the following specimens :—

P. 923, P. 3687. Slab with several fishes and two detached specimens ; Lower Purbeck, Vale of Wardour.

Egerton & Enniskillen Colls.

P. 444, P. 4730. Two fine specimens ; Vale of Wardour.

Presented by Rev. P. B. Brodie, 1885.

The type specimen of *Oxygonius tenuis* is in the collection of Rev. P. B. Brodie, Rowington, Warwick.

family Anaethalionidae · J. Gaudant, 1966, Bull. Soc. géol. Fr. (7) 8: 110

ANAETHALION White 1938. Ann. Mag. N.H. (11) II: 319. Non Otten 1841 this, p. 476.

French species revised by J. Gaudant, 1968, Bull. BRGM (2), 4, 1: 95-118

German species revised by O. Nybelin 1967 Acta R. Soc. scient. litt. gothoburg. Zool. 2, 1: 1-53

Genus **AETHALION**, Münster. nec. Aethalion le Pel. T Serv. (1828, Encycl. Meth. (Ins.) X. 765.

[Neues Jahrb. 1842, p. 41.]

Maxilla arched, with a slightly convex dentigerous border; mandible scarcely prominent, and dentary gradually deepening from the symphysis backwards without any marked thickening; teeth minute and closely arranged. Opercular apparatus as in *Leptolepis*. Vertebral centra strengthened by delicate longitudinal ridges of secondary ossification. Dorsal fin opposed to the space between the pelvic pair and the anal, the latter comparatively small and not extended; caudal fin deeply forked. No enlarged or thickened ridge-scales.

AN**Aethalion knorri** (Blainville).

1755. Figure by G. W. Knorr, Samml. Merkwürdigk. Natur, pl. xxx. fig. 2.

1818. *Clupea knorri*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 331.

1839. *Caturus angustissimus*, G. von Münster, Neues Jahrb. p. 679. [Imperfect fish; Palæontological Museum, Munich.]

1842. *Aethalion inflatus*, G. von Münster, *ibid.* p. 42. [Ditto, counterpart in British Museum.]

1842. *Aethalion angustissimus*, G. von Münster, Beitr. Petrefakt. pt. v. p. 60, pl. v. fig. 3. [Imperfect fish; Palæontological Museum, Munich.]

1844. *Leptolepis crassus*, L. Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 131, pl. lxi. *a*. fig. 5. [Imperfect fish; Erlangen Museum.]

1861. *Aethalion angustissimus*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 40, fig. 6.

1861. *Aethalion inflatus*, T. C. Winkler, *ibid.* p. 42, fig. 7.

1861. *Aethalion tenuis*, T. C. Winkler (*errore*), *ibid.* p. 44, fig. 8.

1863. *Aethalion blainvillei*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 728. [New name.]

1863. *Aethalion crassus*, A. Wagner, *ibid.* p. 730.

Type. Nearly complete fish.

not so, fide Nybelin 1967

The type species, attaining a length of about 0·2. Length of head with opercular apparatus much exceeding the maximum depth of the trunk, and contained somewhat more than four times in the total length of the fish. Vertebræ 50 in number. Dorsal fin with about 15 rays, arising at the middle point of the back; pelvic fins arising immediately in advance of the dorsal, but slightly nearer to the anal than to the pectorals; origin of anal fin, which has about 10 rays, midway between the pelvic and caudal fins.

Relationships of Anacthalion, P. Forey 1973, Bull BM Geol. Suppl. 10, 35-44
" " 1973, "Interrelationships of Fishes".

Leptolepis grandis and L.? elegans,
H. Brahms, Die Fischfauna des Barrêmien
bei Hildesheim (Inaug. Dissert. Tübingen, 1913-19).

Leptolepid.?) euspondylus, W. K. Gregory,
Bull. Amer. Mus. N. H. vol. xlviii (1923), p. 236, fig.
6. — Jurassic; Cuba. [Head, &c.; A.M.N.H.]

Lept. Aspis (?) minor sp. n. L. del. Corpo E. Cassen 1960
Ann. Mus. r. Afr. Cent. 39: 47 pl. VI. Fish remains.

1967. A. angustissimus, O. Nybelin, Acta r. Soc. sci. litt. gothoburg, zool., 2 : 17, pls 3, 7, 8; text-fig 3.
1973 A. angustissimus, P. Forey, Bull. BM (Geol.) Suppl. 10, fig. 18 C

1968 A. lennoni, J. Gaudant, Bull. BRGM, (2) 4; 96, Pl. 1, fig. 1, + text-fig 2
1973 A. lennoni, P. Forey Bull. BMNH geol., Suppl. 10: 35, fig. 18D
1967 A. lennoni, O. Nybelin, Acta r. Soc. sci. litt. gothoburg, zool., 2, 8: 13, pls 1, 4, 6 + text-figs 2, 5c
1966 Anacthalion lennoni J. Gaudant, C.R. Soc. géol Fr 1966 (8): 308 fig. 1
1906. Aethalion knorri, E. Heineke, Geol. u. Paläont. Abhandl. vol. xii. p. 205.
(?) 1914. Æthalion knorri, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 422, pl. lxxiii. fig. 4.
1949. Anacthalion knorri P. de Saint-Seine Ann. Soc. Linn. Mus. H.N. Lyon 2 p. 240 fig. 107-9. pl. xxiv f. E.F.

L97

Anaethalion magni n. sp., O Nybelin 1967, Acta r. Soc. sci. litt. gothoburg, zool. 2:24, pl 4 fig 2, holotype Naturwiss. Inst., Eichstätt.

Anaethalion sp., O. Nybelin 1967, p. 26, pl 8 & text-fig 4; BMNH 37042

37042 shows large bony gill-rakers, noticed by A.S. Woodward, Foss. Fishes Weald. & Purb. Form. 1919 (Pal. Soc 1917), p. 131.

1949. Anaethalion angustus P. de Saint-Seine N. Arch. Mus. H.N. Lyon 2 p. 244.

1967. Anaethalion angustus, O. Nybelin, Acta r. Soc. sci. litt. gothoburg, zool., 2; p. 8, pls 1; 6, fig. 2; 8, fig. 9, text-fig. 1.

1973 A. angustus P. Forey Bull BM (Geol.) Suppl. 10, fig. 18B

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

49130. Plaster cast of fine specimen noticed by Wagner, *loc. cit.* p. 729; Eichstädt. *Purchased*, 1878.

49134. Plaster cast of type specimen of so-called *Aethalion inflatus*; Kelheim. *Purchased*, 1878.

P. 1095. Counterpart of the same, showing most of the principal characters of the species; Kelheim. *Egerton Coll.*

37903. Nearly complete fish displaying the form of the mandible and the situation of the fins; Solenhofen. *Häberlein Coll.*

37042. Remains of a coiled-up fish, in counterpart, displaying the jaws and caudal fin; Solenhofen. *Häberlein Coll.*

32477. Another imperfect specimen, wanting dorsal and anal fins; Solenhofen. *Tesson Coll.*

Type-species of genus, O Kybelin 1967

An **Aethalion angustus,** Münster.

1839. *Caturus angustus*, G. von Münster, Neues Jahrb. p. 679.
1842. *Aethalion angustus*, G. von Münster, *ibid.* p. 42.
1842. *Aethalion tenuis*, G. von Münster, *ibid.* p. 42. [Imperfect fish; Palæontological Museum, Munich.]
1842. *Aethalion parvus*, G. von Münster, *ibid.* p. 43. [Ditto.]
1863. *Aethalion tenuis*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 730.

Type. Imperfect fish; Palæontological Museum, Munich.

A small fish, possibly the young of the preceding species (as suggested by Wagner), but with a more slender trunk. The specimen noticed below, which is labelled by Münster, also has the anal fin slightly further forwards than in *A. knorri*.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

P. 3575. Fish measuring 0·075 in length without the caudal fin, which is wanting; Kelheim. The head with opercular apparatus measures about 0·02 in length, while the maximum depth of the trunk appears to have been 0·013. Ten supports can be counted in the anal fin, and there are distinctly more in the dorsal. The vertebral centra are fully formed and are suggestive of an adult fish. *Enniskillen Coll.*

A. angustissimus fide O. Kybelin 1967: 20

The following specimens of *Aethalion* are not specifically determined:—

P. 3656. A nearly complete, deeply fusiform fish, labelled "*Pachicormus latus*" by Münster; Lithographic Stone, Kelheim. The specimen wants the extremity of the snout, but must have originally measured about 0·175 in length, while the maximum depth of the trunk is 0·04. About 50 vertebral centra can be counted. The dorsal fin shows 16, and the anal fin 10 rays, the foremost support of the dorsal being slightly fan-shaped and apparently composed of two rods meeting at an acute angle, with an intervening wing of bone. The pelvic fins arise opposite the anterior end of the dorsal, while the origin of the anal is midway between the former and the caudal. Intermuscular bones are conspicuous both above and below the vertebral column as far as the middle of the caudal region.

Enniskillen Coll.

P. 3723. Hinder abdominal and caudal region of a similar fish; Kelheim. The supports of the dorsal fin exhibit small wing-like expansions. *Enniskillen Coll.*

P. 3728. Nearly complete fish 0·105 in length, of similar proportions but fractured across the middle; Kelheim. The axial skeleton and median fins are well exhibited.

Enniskillen Coll.

37926. More slender fish 0·13 in length, resembling *A. knorri*, but with more remote pelvic fins; Solenhofen.

Häberlein Coll.

37927. Slender fish about 0·105 in length, with similarly remote fins; Solenhofen. *Häberlein Coll.*

37065. Fish 0·068 in length, in counterpart; Solenhofen.

Häberlein Coll.

37056. Equally small fish, with remarkably advanced anal fin; Solenhofen. See p. 529, MS. *Häberlein Coll.*

A fish from the Lithographic Stone (Lower Kimmeridgian), Cirin, Ain, France, now in the Palæontological Museum, Munich, closely resembles *A. angustus*, and is provisionally named *Aethalion affinis* by A. Wagner, Gelehrte Anzeig. k. bay. Akad. Wiss. vol. l. (1860), p. 405, and Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. (1863), p. 730, footnote.

P.3656 shows minute blunt teeth clustered on an internal bone, probably entopterygoid.

1956. A.V., J.R. Bataller, Bol. Inst. geol. Espoña 67: 113 pl. xiii

1951. A. cf. vidali, L.F. Conrad et St. Com. Inst Geol España 23 p. 8 pl. f. i.

Aethalion vidali, Sauvage.

1903. Aethalion vidali, H.E. Sauvage, Mem. R. Acad. Cienc. Barcelona, [3] vol. iv, no. 35, p. 13, pl. ii. fg. 2.

Type. — Nearly complete fish.

1973 Anaethalion vidali, P. Forey Bull BM Geol. Suppl. 10: 35, figs 16, 17, 19

Fm. d'Les. — Upper Jurassic (Kimmeridgian): Montsech, Lérida, Spain.

P. 10375-76. Fine specimen and a more distorted skeleton. Purchased, 1906.

Aethalion gigas — see p. 494.

also A. valdensis (Woodward), see p. 516

type-species of Aethalionopsis gen. nov. 1966, J. Gaudant, CR. Soc. géol. Fr, 1966, 8, p. 308

Aethalion robustus, Traquair.

1911. Aethalion robustus, R.H. Traquair, Mém. Inst. Roy. d'Hist. Nat. Belg. vol. vi. p. 50, pl. xi, text-figs. 19, 20.

1915. Aethalion robustus, G. D'Erasmo, Palaeont. Italica, vol. xxi. p. 15, pl. i. fig. 8, text-figs. 22.

1912. Aethalion robustus, F. Bassani & G. D'Erasmo, Mem. Soc. Ital. Sci. [3] vol. xvii. p. 234, pl. iii. f. 3, pl. vi. f. 1, 2, text-f. 13-15.

1937. Aethalion robustus Lorenzo, p. 87 text-f. 33.

1960. Aethalionopsis robustus Casier, Les Gaudant de Bernissart, 75 pl. 27, 28.

1966 Aethalionopsis robustus (Traquair) J. Gaudant, CR Soc. géol Fr, p. 308+ fig. 2

Aethalion carolinii, Bassani & D'Erasmo, Le p. 478, MS.

Anaethalion-Arten: O. Nybelin 1967: Act. Reg. Soc. Sci. Litt. Gothl. (Zool.) 2. 53 pp., 8 pls., 5 figs.

A. civinensis n. sp., J. Gaudant 1968, Bull. BRGM (2) 4: 99, pl. 1, fig. 4; Cenin, holotype Lyon Museum.

Carso Thrissops de-lorenzoi 9-15-n.

A. Acc. Caso Trait. 5e Erasmo 1946 p. 41 fig. 16 pl. i. f. iii.

Thrissops? sp. from Kunduistan of B.M.

Heckel identifies a gular plate (Denkschr. k. Akad. wiss. vol. xi. 1856, p. 243).

'Ancestral' to Chirocentrids, Pde Saint-Seine C.R. Somm. Soc. Géol. France, 1945 p. 226.

1914. Thrissops formosus, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 423, pl. lxxii. fig. 2.

1919. Thrissops formosus, var. mordax, H. Brahms, Fischfauna Barrêmien b. Hildesheim (Inaug. Diss. Tübingen).

1925. Thrissops formosus, T. D. A. Cockerell, Bull. Am. Mus. N.H. vol. li, Art. viii, p. 315, pl. 3, fig. 2. [Scales.]

1929. Thrissops formosus, Neumayer, Centralbl. f. Min. Abt. B. No. 10 p. 499 fig. 1-2. VIVARAROUS.

1949. T. f. P. de Saint-Seine N. arch. mus. H.N. Lyon 3 p. 26 f. 116-117 pl. xxvi/A. Ind. T. leachi p. 527

1958. T. f. O. Nybelin Arkiv Zool. (2) 11 28:447 fig. 1, 2, 5, 6, 8. NOT VIVARAROUS

Genus **THRISSOPS,** Agassiz.

[Poiss. Foss. vol. ii. pt. i. 1833, p. 12.]

Head small and teeth minute; sclerotic ossified. Maxilla arched, with a slightly convex dentigerous border; mandible prominent, the dentary apparently intermediate in form between that of *Leptolepis* and *Aethalion*. Opercular apparatus as in *Leptolepis*. Vertebral centra well ossified, strengthened by a median lateral ridge; the free neural arches in the abdominal region much elongated and thickened, the ribs also especially robust. Pelvic fins much smaller than the pectorals; dorsal fin small and short-based, opposite to the anal fin, which is acuminate in front and much extended behind; caudal fin forked. Scales completely covering the trunk; no enlarged or thickened ridge-scales.

Thrissops formosus, Agassiz.

1833–44. *Thrissops formosus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12; pt. ii. p. 124, pl. lxv. *a*.

1844. *Thrissops subovatus*, L. Agassiz (*ex* Münster, MS.), *ibid.* pt. ii. p. 128 (undefined). [Fish; Palæontological Museum, Munich.]

1839. *Thrissops ovatus*, G. von Münster, Neues Jahrb. p. 680. [Fish; Palæontological Museum, Munich.]

1852. *Thrissops formosus*, F. A. Quenstedt, Handb. Petrefakt. p. 219, pl. xvii. fig. 19.

1863. *Thrissops formosus*, A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 734.

1863. *Thrissops subovatus*, A. Wagner, *ibid.* p. 734.

1888. *Thrissops formosus*, K. A. von Zittel, Handb. Palæont. vol. iii. p. 273, figs. 280, 281.

Type. Nearly complete fish; Palæontological Museum, Munich.

The type species, attaining a length of about 0·5. Head with opercular apparatus occupying from one-eighth to one-seventh of the total length of the fish; maximum depth of trunk much exceeding the length of the head with opercular apparatus, and contained about three-and-a-half times in the length of the trunk from the pectoral arch to the base of the caudal fin. Vertebræ at least 60 in number, about 32 being abdominal and 28 caudal. Pelvic fins arising much nearer to the anal than to the pectorals and comprising about 5 rays; dorsal fin, with 14 rays, arising somewhat behind the origin of the anal, which is much elevated in front and comprises not less than 30 rays; caudal fin very deeply forked and the lobes slender. Scales partly ornamented with delicate radiating striæ.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

49139. Plaster cast of fine specimen in the Palæontological Museum, Munich, 0·46 in length; Kelheim.
Purchased, 1878.

P. 3678. A fine and equally large specimen, but more imperfectly preserved and wanting the greater part of the head; Kelheim. The anterior forked support of the dorsal fin is well shown. *Enniskillen Coll.*

35013. Well-preserved specimen about 0·35 in length, with indications apparently of fine ova in the abdominal region; Solenhofen. *Purchased*, 1860.

P. 913. Similar fish, more fractured, wanting the dorsal and part of the caudal fin; Kelheim. *Egerton Coll.*

P. 3684. Another equally large specimen with well-preserved caudal fin; Kelheim. *Enniskillen Coll.*

P. 3683. Fish 0·32 in length, the caudal fin preserved only in impression, labelled *Thrissops propinquus* by Münster; Kelheim. *Enniskillen Coll.*

P. 7590. Part of large head and abdominal region, with some stout rays of the pectoral fins; Solenhofen.

P. 3678 a, P. 3683 a. Two fragments, the second showing part of the head with some stout teeth in the upper jaw; Kelheim. *Enniskillen Coll.*

P. 913 a, b. Two fragments of trunk; Kelheim. *Egerton Coll.*

P. 917. Imperfect small contorted skeleton, probably of this species; Kelheim. *Egerton Coll.*

P. 920. Greater portion of well-preserved trunk of small fish, probably of this species; Kelheim. The anterior acuminate elevation of the anal fin is especially well shown.
Egerton Coll.

Thrissops salmoneus (Blainville).

1755. Figure by G. W. Knorr, Samml. Merkwürdigk. Natur, pl. xxxi. fig. 1.

1818. *Clupea salmonea*, H. D. de Blainville, Nouv. Dict. d'Hist. Nat. vol. xxvii. p. 331.

1833–44. *Thrissops salmoneus*, L. Agassiz, Poiss. Foss. vol. ii. pt. i. p. 12; pt. ii. pp. 128, 293.

P.3678. Rib articulated to fit on slight ridge on centrum. Except in anterior half of abd. region, a median lateral ridge on all centra; about 10 hæmals within caudal fin; intercalary supports in hinder part of dorsal & anal fins. Some anterior scales tuberculated.

35013. Large smooth ptt. Intercalaries in dorsal & anal fins. Anterior scales, tuberculated not serrated.

P.913. Largest teeth in pmx. Smooth op. bones. Large smooth ptt. Tubercles on anterior scales in radiating rows; caudal scales smooth. Pelvic fin-supports not expanded.

P.3683. Smooth op. app. & cheek plates. Ova seen.

P.7590 is a Lebanon fish, evidently Ichthyodectes libanicus.

P.3678a has 4 short fulcral rays at origin of anal fin.

P.3683a. Tuberculate ornament especially well shown on anterior dorsal scales; not clear on scales below vert.

P.917 shows large bony gill-rakers among remains of gill-arches. Seems to show a supraoccipital crest, but crushed cranial roof apparently not that of an Ichthyodectid. Gill-rakers noticed by A.S. Woodward, Foss. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 131. Occ. crest noticed op. cit. p. 137.

P.913a. Median dorsal scales fig. Cockerell Ver. cit. 1925.

1914. *Thrissops salmoneus*, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 423, pl. lxxii. fig. 1.

37078 has 12 hdemals within base of caudal fin.

1906. *Thrissops clupeoides*. E. Heinecke, Geol. u. Paläont. Abhandl. vol. xii. p. 212.

1949. T. teglegi, P. de Saint-Seine, N. Arch. Mus. H.N. Lyon 2 p. 273, pl. xxvi f. B.

1844. *Thrissops mesogaster*, L. Agassiz, *ibid.* vol. ii. pt. ii. pp. 128, 293. [Nearly complete fish; Palæontological Museum, Munich.]
1848. *Thrissops gracilis*, C. G. Giebel, Fauna d. Vorw., Fische, p. 151. [Nearly complete fish; Halle University Museum.]
1848. *Thrissops salmoneus*, C. G. Giebel, *ibid.* p. 152.
1848. *Thrissops mesogaster*, C. G. Giebel, *ibid.* p. 152.
1863. *Thrissops salmoneus* (including var. *angustus*, Münster, MS.), A. Wagner, Abh. k. bay. Akad. Wiss., math.-phys. Cl. vol. ix. p. 735.

Type. Nearly complete fish; Museum of Natural History, Paris.

A species attaining a length of about 0·35. Head with opercular apparatus occupying about one-sixth of the total length of the fish; maximum depth of trunk less than the length of the head with opercular apparatus, and contained about five times in the length of the trunk from the pectoral arch to the base of the caudal fin. Vertebræ and fins as in the type species, except that the caudal is much less deeply forked and with broader lobes.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria.

37078. Contorted specimen about 0·335 in length, in counterpart; Solenhofen. *Häberlein Coll.*

P. 3679. Fine specimen somewhat fractured, 0·27 in length, labelled *Thrissops mesogaster* by Agassiz; Eichstädt. *Enniskillen Coll.*

37069. Similar specimen 0·25 in length, in counterpart; Solenhofen. *Häberlein Coll.*

P. 3682. A smaller, more imperfect fish, labelled *Thrissops angustus* by Münster; Kelheim. *Enniskillen Coll.*

Thrissops clupeoides, Winkler.

(?) 1854. *Thrissops regleyi*, V. Thiollière, Poiss. Foss. Bugey, pt. i. pl. x. fig. 2 (figure only).
1861. *Thrissops clupeoides*, T. C. Winkler, Descript. Poiss. Foss. Solenhofen (Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv.), p. 21, fig. 3.

Type. Nearly complete fish; Teyler Museum, Haarlem.

A species attaining a length of about 0·25. Head with opercular apparatus contained between five and five-and-a-half times in the total length of the fish; maximum depth of trunk equalling the length of the head with opercular apparatus, contained between

three-and-a-half and four times in the length of the trunk from the pectoral arch to the base of the caudal fin. Vertebræ and fins as in *T. salmoneus*.

Form. & Loc. Lower Kimmeridgian (Lithographic Stone): Bavaria, and (?) Ain, France.

37819. Large much-fractured specimen 0·25 in length; Solenhofen. The number of vertebræ between the occiput and the hinder border of the operculum is shown to be six. *Häberlein Coll.*

P. 3680. Less imperfect specimen 0·203 in length; Kelheim. *Enniskillen Coll.*

37828. Somewhat smaller fish, in counterpart; Solenhofen. *Häberlein Coll.*

P. 917 a. Fine specimen 0·175 in length, labelled *Thrissops propinquus* by Münster; Kelheim. *Egerton Coll.*

P. 916. Another fine specimen nearly as large as the last, showing an undigested fish (apparently *Leptolepis*) in the abdomen; Solenhofen. *Egerton Coll.*

P. 3680 a, b. Similar but contorted specimen, and a smaller fish; Kelheim. *Enniskillen Coll.*

P. 915. Four smaller specimens; Kelheim. *Egerton Coll.*

P. 918, P. 921. Three imperfect specimens of the fish named *Thrissops regleyi* by Thiollière, probably referable to this species; Cirin, Ain, France. *Egerton Coll.*

P. 4688. Similar fish 0·145 in length, preserved chiefly as an impression; Cirin. *Purchased*, 1884.

P. 4689. Imperfect contorted specimen, in counterpart; Cirin. *Purchased*, 1884.

The following small specimens are doubtless to be regarded as immature individuals of some or all of the three foregoing species. The head with opercular apparatus occupies somewhat more than one-fifth of the total length of the fish, and similar specimens have received the names of *Thrissops cephalus* (Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 125, pl. lxi. figs. 1–3: Palæontological Museum, Munich) and *Thrissops micrurus* (Winkler, Natuurk. Verhandl. Holland. Maatsch. [2] vol. xiv. 1861, p. 14, fig. 2: Teyler Museum, Haarlem).

P.916. Shows branches from slime-canal on posterior suborbitals. Anterior neural spines with expansion back & front.

P.915. One shows cluster of minute teeth on ento-pterygoid.

T. Cephalus O Nybelin Ark. Zool. (2) 11, 28 (1958) Tf 448 Fig 3,7.

37928. Well-preserved fish 0·08 in length; Solenhofen.
Häberlein Coll.

P. 3680 c, P. 3681, P. 3685. A slightly larger specimen and two smaller, the second labelled by Münster "*Thrissops salmoneus*, var. *brevis*"; Kelheim. *Enniskillen Coll.*

P. 914. Impression of fish 0·07 in length; Mörnsheim.
Egerton Coll.

37816–18. Three specimens from 0·06 to 0·032 in length; Solenhofen. *Häberlein Coll.*

Thrissops rochei, Sauvage.

1893. *Thrissops rochei*, H. E. Sauvage, Bull. Soc. Hist. Nat. Autun, vol. vi. p. 436, pl. viii. fig. 2.

Type. Nearly complete fish.

A species attaining a length of about 0·18. Length of head with opercular apparatus about equal to the maximum depth of the trunk, and contained five times in the total length of the fish. Vertebræ about 60 in number. Pelvic fins arising much nearer to the anal than to the pectorals; dorsal fin, with about 14 rays, arising opposite the origin of the anal, which has 40 rays; caudal fin less deeply forked and with broader lobes than in the type species.

Form. & Loc. Lower Kimmeridgian: Orbagnoux, Ain, France.

Not represented in the Collection.

Thrissops portlandicus, sp. nov.

[Plate XVIII. fig. 4.]

Type. Nearly complete fish; British Museum.

A species attaining a length of about 0·35, perhaps sometimes larger. Length of head with opercular apparatus somewhat exceeding the maximum depth of the trunk and contained five times in the total length of the fish. Vertebræ at least 60 in number, about 35 being abdominal and 25 caudal. Pelvic fins arising much nearer to the anal than to the pectorals; dorsal fin, with about 12 rays, arising opposite the origin of the anal, which has at least 25 rays; caudal fin very deeply forked and the lobes slender.

Form. & Loc. Portlandian: Dorsetshire.

P. 5538. The type specimen in counterpart, one side shown of half the natural size in Pl. XVIII. fig. 4; Portland Stone, Isle of Portland. The head is very imperfect, the jaws

and rostral region wanting. A close series of branchiostegal rays (*br.*) is indicated on the side figured, while the large dimensions of the preoperculum are shown by the counterpart. The vertebral centra are longitudinally split, but their appended arches are well exhibited, and intermuscular bones are very numerous in the dorsal part of the abdominal region. The relative proportions of the paired fins are indicated by fragments, and the slender proximal ends of the pair of pelvic fin-supports can be seen. The median fins are imperfect, but the origin of the dorsal fin is observed to be opposite that of the anal fin, the former displaying about 12 rays and the latter at least 25 rays, of which only the basal ends and supports remain. The lower caudal lobe is perfect in the counterpart, from which it is restored in the figure; the articular dividing lines exhibit the characteristic step-like arrangement. *Presented by F. Harford, Esq.*, 1888.

Thrissops microdon, Heckel.

1849–50. *Chirocentrites microdon*, J. J. Heckel, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. 1849, pt. i. p. 18, and Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. i. p. 209, pls. xvi., xvii.

1856. *Thrissops microdon*, J. J. Heckel, *ibid.* vol. xi. p. 243.

1863. *Chirocentrites microdon*, A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix. p. 734, footnote.

1879. *Thrissops microdon*, F. Bassani, Verhandl. k. k. geol. Reichsanst. p. 163.

1882. *Thrissops microdon*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 208, pl. iii.

Type. Head and abdominal region; Court Museum, Vienna.

A species attaining a length of about 0·45. Length of head with opercular apparatus about equalling the maximum depth of the trunk, and contained seven times in the total length of the fish. Vertebræ at least 60 in number, about 33 being abdominal and 27 caudal. Pelvic fins nearly twice as distant from the pectorals as from the anal; dorsal fin, with about 14 rays, arising opposite the middle of the anal, which is much elevated in front and comprises nearly 40 rays; caudal fin very deeply forked.

Form. & Loc. Cretaceous: Isle of Lesina, Dalmatia.

P. 7451. Imperfect fish wanting the region behind the origin of the anal fin. *Purchased*, 1895.

Thrissops curtus, A.S. Woodw.

1919. *Thrissops curtus*, A.S. Woodward, Foss. Fishes Weald & Purb. Form. (Pal. Soc. 1919). p. 137, pl. xxvi. fig 1.

P. 10612. Type specimen; L. Purbeck, Portland. Purl.: 1908.

1946. T. m. G. Di Erasmo p. 45 fig. 15 (rest.).

T. c. 1946 D Erasmo p. 58.

Thrissops sp. Wealden: Lebanon, 1925, W. Tarrensch, L.d.s. Q. LXXV (1924) p. 58. not →.

see also VII.iv p. 91, 92

Thr. leckeli, C. R. Eastman, Mem. Carnegie Mus. vol. vi. p. 388.

P. 5731. Imperfect head, pectoral fin, and anterior abdominal region. *Purchased*, 1888.

P. 7450. Imperfect example probably of this species. *Purchased*, 1895.

Thrissops exiguus, Bassani.

(?) 1867. *Chirocentrites microdon* ?, R. Kner, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. lvi. pt. i. p. 193, pl. iv.

1879. *Thrissops exiguus*, F. Bassani, Verhandl. k. k. geol. Reichsanst. p. 163.

1882. *Thrissops exiguus*, F. Bassani, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. xlv. p. 210, pl. vi. figs. 1, 2.

Type. Imperfect fish; Imperial Geological Survey, Vienna.

A species closely resembling *T. microdon*, but described by Bassani as distinguished from the latter by the greater development of the pectoral fins, the more remote situation of the pelvic fins, the slightly greater number of vertebræ, and other characters.

Form. & Loc. Cretaceous: Island of Lesina, Dalmatia, and (?) Comen, Istria.

Not represented in the Collection.

Thrissops, sp.

1889. *Thrissops* sp. (cf. *T. heckeli*, Thiollière), A. S. Woodward, Geol. Mag. [3] vol. vi. p. 455.

An indefinable large species apparently related to *T. formosus* and *T. heckeli*,[1] known only from the undermentioned fragments. The head seems to have been comparatively small and the trunk deep; the length of the head with opercular apparatus being less than the maximum depth of the trunk. The small dorsal fin arises behind the origin of the anal fin.

Form. & Loc. Kimmeridgian: Dorsetshire.

40336. Remains of greater portion of trunk with caudal fin about 0·5 in length; Chapman's Pool, Kimmeridge. *Purchased*, 1867.

41219. Fragmentary fish about 0·4 in length; Kimmeridge. *Presented by J. C. Mansel-Pleydell, Esq.*, 1868.

[1] Under this name an imperfect large fish from the Lithographic Stone (Lower Kimmeridgian) of Cirin, Ain, France, is figured without description by V. Thiollière, Poiss. Foss. Bugey, pt. i. (1854), pl. x. fig. 1. The specimen is now in the Lyons Museum. = T. formosus 2nd. p. 520.

P. 922, P. 3686. Imperfect anterior portion of fish, in counterpart; Kimmeridge. *Egerton & Enniskillen Colls.*

P. 6031. Middle portion of trunk, showing part of the dorsal and anal fins; Dorsetshire.
Presented by George Clifton, Esq., 1889.

P. 922 a, P. 3686 a. Fragments; Kimmeridge.
Egerton & Enniskillen Colls.

The following specimens of *Thrissops* are not specifically determined:—

37086. Well-preserved specimen 0·36 in length, in counterpart, exhibiting all the fins; Lower Kimmeridgian (Lithographic Stone), Solenhofen. The head with opercular apparatus is contained nearly seven times in the total length of the fish; the maximum depth of the trunk equals the length of the head with opercular apparatus, and is contained nearly five times in the length of the trunk from the pectoral arch to the base of the caudal fin. Vertebræ and fins almost as in the type species, but the anal relatively more elongated by the spacing of the rays, and the caudal much less deeply forked, with broader lobes.
Häberlein Coll.

P. 937, P. 3676. Remains of slender fish originally about 0·2 in length, the anterior portion in counterpart; Oxford Clay, Christian Malford, near Chippenham, Wiltshire. The specimen is labelled *Leptolepis costalis* by Egerton, and is evidently intended to be the type specimen of that species named in Quart. Journ. Geol. Soc. vol. i. (1845), p. 231. The length of the head with opercular apparatus must have considerably exceeded the maximum depth of the trunk, but it is very imperfect; the caudal region is also almost wanting. All the vertebral centra are somewhat longer than deep, and 28 pairs of stout ribs are exhibited. The long and delicate intermuscular bones are conspicuous as usual above the vertebral column. Of the fins, only a fragment of the pectoral pair remains.
Egerton & Enniskillen Colls.

P. 417 a. Imperfect remains of a fish about 0·35 in length; Purbeck Beds, Swanage. The cranium is wanting from the head, while portions of the vertebral column are missing from the middle of the abdominal, and the front of the

P. 417 a, type specimen of *Thrissops molossus*, A. S. Woodward, Foss. Fishes Weald. & Purb. Form. 1919 (Pal. Soc. 1917), p. 138, pl. xxvi. fig. 2.

Eurysichthys vinalesensis, gen. et sp. nov. 1942,
T. E. White, Proc. N. England Zool. Club. 21 p. 97.
pl. xix. M. Swan. (Oxf.): Cuba [Fish: M.C.Z.].

See Pachythrissops, p. 493, above.

Parathrissops, C. R. Eastman (non Sauvage), Mem.
Carnegie Mus. vol. vi (1914), p. 423.

Parathrissops furcatus, C. R. Eastman, loc. cit. 1914,
p. 423, pl. 7ix. fig. 2. — Litho. Stone; Solenhofen. [Fish;
Carnegie Mus., Pittsburgh.]

37056. Probably young of above.

Eurysthethus may be Pachythrissops, A. S.
Woodward, Foss. Fishes Weald & Purb. Form. 1919
(Pal. Soc. 1917), p. 129. Name repl. by Eurystichthys
G. P. Shirley 1930 Proc. R. Z. Soc. N. S. Wales 8-49 p. 444

caudal region. The length of the head with opercular apparatus is probably about equal to the maximum depth of the trunk, and is contained five times in the total length of the fish. The eye is remarkably large, as shown by the well-preserved sclerotic. The upturned mouth is bordered above by the very small premaxilla, and the long arched maxilla which bears minute teeth. The vertebral centra are about as long as deep, except towards the base of the tail, where they are somewhat longer. One of the hæmal spines is seen to be considerably expanded. The origin of the anal fin is distant 0·145 from the pectorals and 0·09 from the caudal fin. *Fox Coll.*

46319. Trunk about 0·51 in length, wanting head and caudal fin; Purbeck Beds, Swanage. The specimen is very imperfect, but the dorsal fin is shown to arise opposite the origin of the anal, which has at least 23 rays. There seem to be remains of intermuscular bones below the vertebral column in the caudal region. *Cunnington Coll.*

P. 4535–36. Two imperfect examples of a small species with remarkably short and deep abdominal vertebræ; Purbeck Beds, Swanage. *Enniskillen Coll.*

= Pachythr. laevis. See p. 493. Noticed A.S.W. 1919, pp. 130, 132.

44845. Imperfect head and trunk of the same species: probably from Swanage. The preoperculum exhibits a few radiating ridges, and the quadrate shows a long hinder process to grasp the symplectic. The pelvic bones and fins are well-preserved; while the dorsal fin, with fan-like foremost support, arises opposite the origin of the anal. As in the three preceding specimens, there seem to be remains of intermuscular bones below the vertebral column in the caudal region.

= Pachythr. laevis. See p. 493.

Presented by Benjamin Bright, Esq., 1873.

P. 1121. Fragment of trunk showing characteristic ribs; Purbeck Beds, Swanage. *Egerton Coll.*

The so-called *Thrissops propterus* (A. Wagner, Abh. k. bay. Akad., math.-phys. Cl. vol. ix. 1863, p. 735) from the Lower Kimmeridgian (Lithographic Stone) of Eichstädt, Bavaria, seems to be a species of *Leptolepis*. The type specimen is in the Palæontological Museum, Munich.

According to the original description, the genus *Eurystethus* (H. E. Sauvage, Bull. Soc. Géol. France, [3] vol. vi. 1878, p. 629)

appears to be related to *Thrissops*, but it is too imperfectly known for definite reference. The type species is *E. brongniarti* (H. E. Sauvage, *ibid.* p. 629, pl. xiii. fig. 2), founded on a fish wanting the end of the caudal region but originally about 0·1 in length, from the Kimmeridgian of Morestel, Isère. Both dorsal and anal fins are extended and the pelvic fins are remote, arising immediately in advance of the origin of the dorsal.

The undefined generic name *Ctenolepis* (L. Agassiz, Poiss. Foss. vol. ii. pt. ii. 1844, p. 180) is applied to certain detached scales of Bathonian age, which probably belong to a member either of the Oligopleuridæ or of the Leptolepidæ. The typical species is *C. cyclus* (L. Agassiz, *ibid.* p. 180; A. S. Woodward, Proc. Geol. Assoc. vol. xi. 1890, p. 301, and vol. xii. 1892, p. 241, pl. iv. figs. 5–8; figures by C. Prevost, Ann. Sci. Nat. vol. iv. 1825, pl. xviii. fig. 21, and by J. Phillips, Geol. Oxford, 1871, p. 182, fig. 41, nos. 1–4) from the Stonesfield Slate, Stonesfield, Oxfordshire. The scales have only been found detached and are mostly imperfect. They must have been very deeply imbricating, and the anterior overlapped border is ragged, a few radiating grooves extending to it from the centre of the scale; the relatively small exposed area is invested with smooth ganoine which exhibits sparse punctations; and the hinder border is either entire or only feebly crenulated. The following scales from Stonesfield are of this character:—

P. 745, P. 3354. Four typical scales figured in Proc. Geol. Assoc. vol. xii. (1892), pl. iv. figs. 5–8.
Egerton & Enniskillen Colls.

P. 745 a–g, P. 3354 a–k. Eighteen specimens.
Egerton & Enniskillen Colls.

47931. One scale. *Presented by the Hon. Robert Marsham*, 1877.

Thaumais fenglioi sp. n. U. Cretac. Chubut, Argentina
A.F. Bordas Physis 19 p. 316 2 pls. Mus. Arg. C.N., B.A.
1943,
Thaumais shamanicus n. sp. U. Cretac. Chubut. Argentina
Not. mus. La Plata. Paleont. 14 M. Bolgopol de Saez
1949 p 443. Fig. 1. (Fish L. Plata)

Thrissops volgensis, s.n., A. Kozlov, 1928, Bull. Com. Geol. Leningrad, XLVII No 5 p. 573 [ref.] pl. xii. Imp. fish in Cenoz. L. Volgian (Periphinctes panderi zone; Gorodische village, Govt of Ulianovsk (form. Simbirsk).

Thrissops vexillifer, vol. IV. p. 92.

Archaeotolithus, Stolley, p. 248.

Archaeotolithus trigonalis, E. Stolley, Jahresb. Niedersächs. geol. Ver., vol. iii (1910), pp. ~~246–256.~~ 249. pl. vii. f. 1–3. — Upper Dogger; near Harzburg, N. Germany.

Atolithus neocomiensis, E. Stolley, loc. cit., p. 254, pl. vii. f. 6–9. — Middle Neocomian; Ahlum, nr. Wolfenbüttel.

Archaeotolithus bornholmiensis (Mall. & Grönw.), E. Stolley, loc. cit. p. 249, pl. vii. f. 4, 5. — M. Lias; Stampen, Bornholm. Malling & Grönwall, Danske geol. Foren. Medd. no. 15, 1909, p. 295, pl. ii, f. 14–18.

Genus Tharrhias, Jordan & Branner. [Smithson. Miscell. Coll. vol. 7ii. 1908, p. 13.]

As Leptolepis but larger operculum more than 4 times as deep as sop. & separated from it by horizontal suture. Vertebrae 50 to 55.

Tharrhias araripis, D. S. Jordan & J. C. Branner, loc. cit. 1908, p. 14, pl. ii. text-fig. 8. — Cretaceous; Ceará, Brazil. [Imperfect fish; Museo Rocha, Ceará. Probably an Elopine. H.W.]

D. S. Jordan, Peixes cretaceos do Ceará e Piauhy (Monogr. Serviço Geol. e Min. Brasil vol. iii [1923 (1924)] p. 21; pl. 3, fig. 1; pl. xvi, fig. 3. (Cearana is a synonym and the species ~~Tharrhias~~ Tharrhias rochae, loc. cit. p. 25; see vol. iv, p. 85.) Cearana rochae [illegible] 1908 Smithson. Misc. Coll. 52, no 1794. 2 pp. 28, pl. 7 f. 4

Tharrhias araripis Thomas 1935 p. 17, pl. v. f. 1.
" rochai " " 19 iii. 1–3; iv. f. 1.

P.7520. Des? & fig? A.S. Woodward, Proc. Yorks. Geol. Polyt. Soc. vol. xiii (1898), p. 467, pl. lxix. fig. 1.

ADDENDA ET CORRIGENDA.

P. 15. Add the following to the list of specimens of *Belonorhynchus acutus*:—

P. 961 a. Portion of jaw, one of the type specimens figured by Agassiz, *loc. cit.* fig. 3; Upper Lias, Whitby.
Egerton Coll.

P. 20. A variety of the so-called *Saurichthys semicostatus* is named *S. angustus* by Münster, *loc. cit.* 1839, p. 119.

P. 35. The following specimen apparently of *Gyrosteus mirabilis* has been obtained since the early pages were printed:—

P. 7520. Slab of pyritous jet rock from the Upper Lias of Whitby, exhibiting a regular series of plates, which seem to be an operculum and suboperculum followed below by seven branchiostegal rays, exposed from the inner aspect. The supposed operculum is relatively small, only one-third as deep as the supposed subo-perculum beneath it. *Purchased*, 1895.

P. 68. An indeterminable crushing-tooth is named thus:—

Sargodon liasicus, E. Dumortier, Etudes Paléont. Dépôts Jurass. Bassin Rhône, pt. ii. (1867), p. 108, pl. xxix. figs. 7, 8. —Lower Lias; Dardilly, Dépt. Rhône.

P. 74. *Dapedius altivelis* is first named *Tetragonolepis altivelis* by Agassiz, Neues Jahrb. 1832, p. 147.

P. 77. To *Colobodus* may also probably be referred the portion of squamation described thus:—

Lepidotus sulcatus, J. J. Heckel, Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. 1849, pt. i. p. 177, and Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. i. (1850), p. 242, pl. xx. fig. 3.—Upper Trias; Raibl, Carinthia.

P. 90. *Lepidotus macrocheirus* is quoted under the name of *L. latimanus* by Agassiz, Poiss. Foss. vol. ii. pt. i p. 305.

Pp. 126, 232, 252, 257. Pietraroja, though in the former kingdom of Naples, is in the modern Province of Benevento, as stated in the later pages of the Catalogue where reference is made to this locality.

P. 153, line 32. *For* "near Naples," *read* "Province of Salerno."

P. 205. The undescribed *Pycnodus gracilis* from the Corallian of Hanover (Münster, Beitr. Petrefakt. pt. vii. 1846, p. 42) is said to be indistinguishable from the so-called *Pycnodus ovalis*. Nothing is known of *Pycnodus latidens* (Agassiz, Poiss. Foss. vol. ii. pt. ii. p. 199) from Soleure.

P. 214. Some indeterminable Pycnodont teeth are described as follows:—

Mesodon abrasus, F. W. Cragin, Colorado College Studies, 1894, p. 72, pl. ii. figs. 18, 19.—Neocomian; Kansas, U.S.A.

P. 231. Add the following:—

Microdon alternans, F. A. Quenstedt, Handb. Petrefakt. ed. 2 (1867), p. 255, pl. xxiii. fig. 1.—Portlandian; Soleure, Neuchâtel. [Imperfect vomer; Tübingen University Museum.]

Microdon cavatus, F. A. Quenstedt, *ibid.* p. 255, pl. xxiii. fig. 4. —Ibid. [Ditto.]

Pp. 248, 249. The generic names *Stemmatodus* and *Cœlodus* were first proposed by Heckel in a preliminary paper in the Sitzungsb. k. Akad. Wiss., math.-naturw. Cl. vol. xii. (1854), pp. 449, 455. Here also the species were arranged as in the memoir of 1856.

P. 265. Add the following:—

Anomœodus carteri, A. S. Woodward, Geol. Mag. [4] vol. ii. (1895), p. 209, pl. viii. fig. 4.—Cambridge Greensand; Cambridge. [Right splenial; Woodwardian Museum, Cambridge.]

Anomœodus confertus, A. S. Woodward, *ibid.* p. 209, pl. viii. fig. 3.—Ibid. [Ditto.]

The Palæoniscid affinities of the Liassic genus *Platysiagum* not having been recognized in 1891, it was omitted in the account of the Palæoniscidæ in Part II. There cannot, however, be much

1 S. W. Williston, Kansas Univ. Quarterly, vol. ix (1900), p. 29, pl. xii. fig. 4 (reprinted in Univ. Geol. Surv. Kansas, vol. vi. 1900, p. 256, pl. xxx. fig. 4).

Platysiagum minus, s.n. Brough 1939, Trias. Fishes Besano, p. 14, Tf. 6, pl. iii. f. 1-3. Trias. Lombardy. [Imp fish: B.M.].

1939. *Pl. sch.* J. Brough, Trias. Fishes Besano, B.M. p. 17.

doubt from the specimens recorded below that the fish truly belongs to this Chondrostean family; a catalogue of the specimens in the Collection is therefore appended here. The upper lobe of the tail, the fin-supports, and the axial skeleton of the trunk still remain unknown; but the demonstrated arrangement of the cheek-plates appears to suffice for determining the systematic position of the genus.

Genus **PLATYSIAGUM,** Egerton.

[Figs. & Descript. Brit. Organic Remains, dec. xiii. (Mem. Geol. Surv. 1872), no. 6.]

Trunk elongate-fusiform. Mandibular suspensorium oblique; dentition consisting of a series of large, well-spaced conical teeth, and numerous smaller teeth irregularly arranged and somewhat clustered; head and opercular bones externally tuberculated, clavicular bones partly rugose. Fins of moderate size, with numerous small fulcra, the rays broad, all much bifurcated and closely articulated distally. Pelvic fins short-based; dorsal fin about as long as deep, arising opposite or nearly opposite the pelvic pair; [anal fin unknown]; caudal fin deeply forked. Scales thin, small or of moderate size, and several ventral series very narrow; ornament comprising feeble, slightly-radiating ridges towards the hinder margin, and sparsely scattered tubercles on the anterior portion.

Platysiagum sclerocephalum, Egerton.

1872. *Platysiagum sclerocephalum,* Sir P. Egerton, *loc. cit.* no. 6, pl. vi.

Type. Imperfect distorted fish; British Museum.

The type species attaining a length of about 0·6. Form and proportions unknown, but head with opercular apparatus large and its length much exceeding the maximum depth of the trunk. Tubercular ornament almost disappearing on the hinder portion of the operculum and suboperculum and on the branchiostegal rays, coarsest and partly replaced by rugæ on the clavicular arch; very fine tubercles also on the two foremost rays of the pectoral fin. Maximum depth of hinder expansion of maxilla equalling about one-third of the total length of the bone, and the dentigerous border slightly sinuous; teeth smooth; suboperculum much more than half as deep as the operculum. Pectoral fin with about 20, and pelvic fin with about 10 rays, the latter half as deep as the former; dorsal fin with at least 16 rays, arising opposite a point immediately behind the pelvic pair. Tuberculations on scales very sparse.

Form. & Loc. Lower Lias: Dorsetshire.

All the following specimens were obtained from the neighbourhood of Lyme Regis:—

P. 3650. Type specimen described and figured by Egerton, *loc. cit.* pl. vi. fig. 1. As proved by the next specimen, the caudal region is much shortened by crushing. A coarsely ornamented elongated plate of ill-defined outline, exposed between the hinder extremities of the mandible, is not improbably an infraclavicle. A portion of the jaws is shown enlarged in Egerton's fig. 3, and some of the teeth are more highly magnified in fig. 4. *Enniskillen Coll.*

P. 3651. Remains of fish about 0·6 in length, displaying the paired fins but otherwise very imperfect. Traces of the endoskeleton are obscure, and the upper lobe of the tail is destroyed beyond recognition. *Enniskillen Coll.*

P. 1333–34. Two imperfect examples of thehead and abdominal region, the second showing the rays of the dorsal fin and noticed by Egerton, *loc. cit.* Both want the snout, but the first displays the hinder portion of the head and the opercular apparatus. The preoperculum is shown to extend over the cheek in the typical Palæoniscid manner; and there seems to be a small plate above the upper end of the operculum. *Egerton Coll.*

P. 558. Remains of head showing jaws, described and figured by Egerton, *loc. cit.* pl. vi. fig. 2. *Egerton Coll.*

P. 3652. Imperfect right maxilla, dentigerous border of mandible, and preoperculum, exposed from the outer aspect.
Enniskillen Coll.

G. D'Erasmo. Cat. pesc. foss. Tre Venezie. (Mem. Inst. Geol. R. Univ. Padova, vol. VI. 1922).

Plate. 5.

+ Lepidotus maximus 27-29.

Plate 6.

Coelodus oblongatus 1.
Mesodon bucklandi 2-5, ?6.
" angulosus 7-8
cfr. gigas 9-10.
Pycnodus sp. 11-16.
Protosphyraena sp. 17.
Calamostoma sp. 18-19.
Lepidotus sp 20-29.
x " maximus 30-34.
" palliatus. 35-38.
Amblychirhys? 39-42.
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Otoliths.

Otol. (inc. sed.) germanicus s.n., ornatus s.n., Haeckeni s.n., irregularis s.n., tenuicostatus s.n. Boggeny: Stuttgart, (H. Reik ?) W. Loeblich 1953, Pal. Zeit. 27 pp. 110-121 pl. 8. [Otol. Stuttgart].

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EXPLANATION OF PLATES.

The specimens represented in the Plates are all preserved in the Collection, and bear the register-numbers placed in square brackets. Unless otherwise stated, the drawings are of the natural size.

PLATE I.

Fig. Page

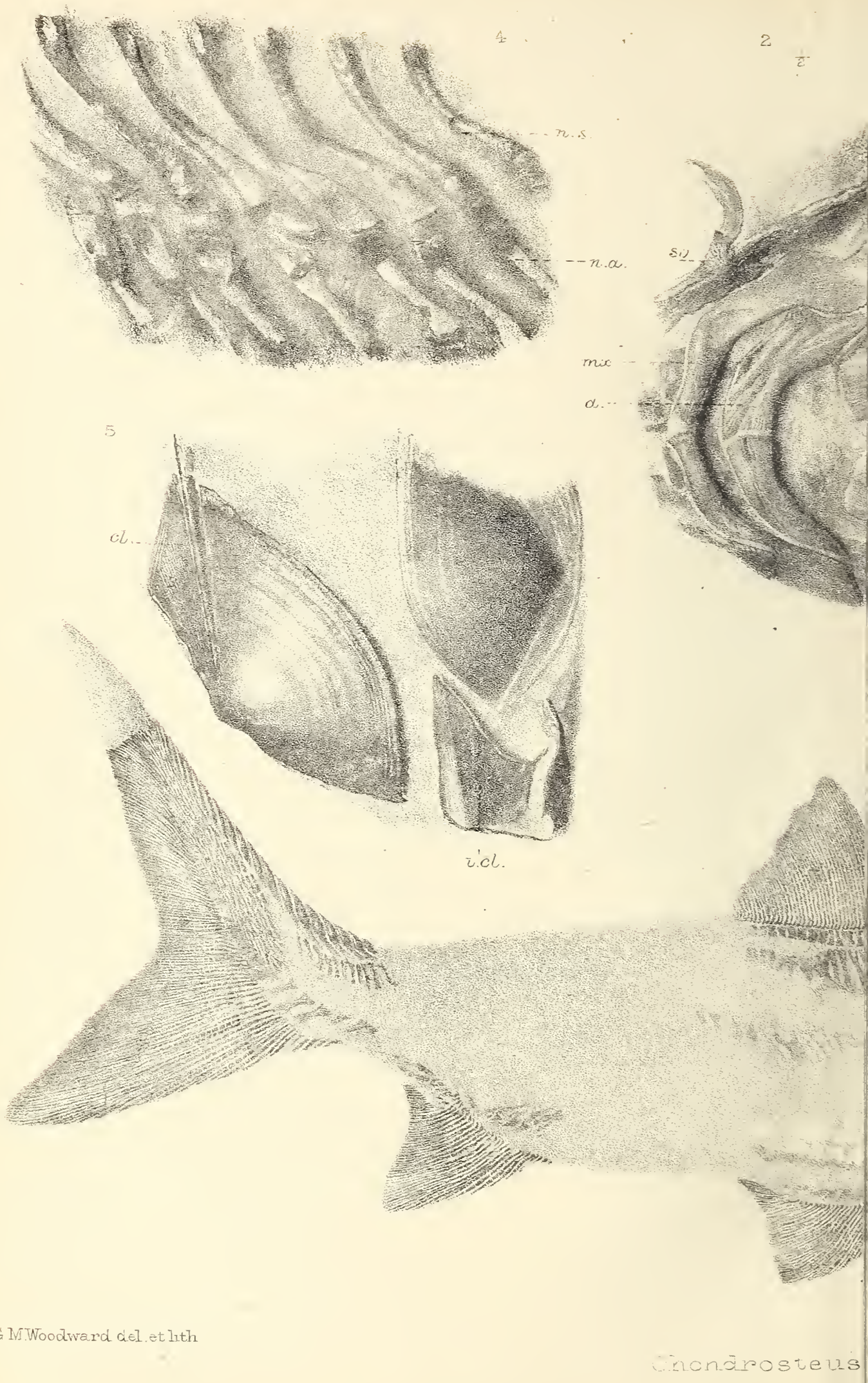
1. *Chondrosteus acipenseroides*, Egerton; lateral aspect, one-quarter nat. size.—Lower Lias; Lyme Regis. *cl.* Clavicle. *hm.* Hyomandibular. *ju.* Jugal. *op.* Operculum. *pt.* Pterygoid. *s.cl.* Supraclavicle. *s.op.* Suboperculum. [P. 3366.] 28

2. Ditto; head and pectoral arch, inferior aspect, one-half nat. size.—Ibid. *br.* Branchiostegal rays. *ch.* Ceratohyal. *d.* Dentary. *i.cl.* Infraclavicle. *mx.* Maxilla. *so.* Suborbital. *x.* Fracture across clavicle. Other letters as above. [P. 2048.] 31

3. Ditto; left Pterygoid (*pt.*), Palatine (*pl.*), Maxillary (*mx.*), and Jugal (*ju.*) bones, outer aspect.—Ibid. [P. 3367.] 29

4. Ditto; neural arches of trunk, right lateral aspect.—Ibid. *n.a.* Neural arch. *n.s.* Neural spine. [P. 2050.] 29

5. Ditto; portion of pectoral arch, visceral aspect.—Ibid. *cl.* Clavicle *i.cl.* Infraclavicle. [P. 4341 b.] 32



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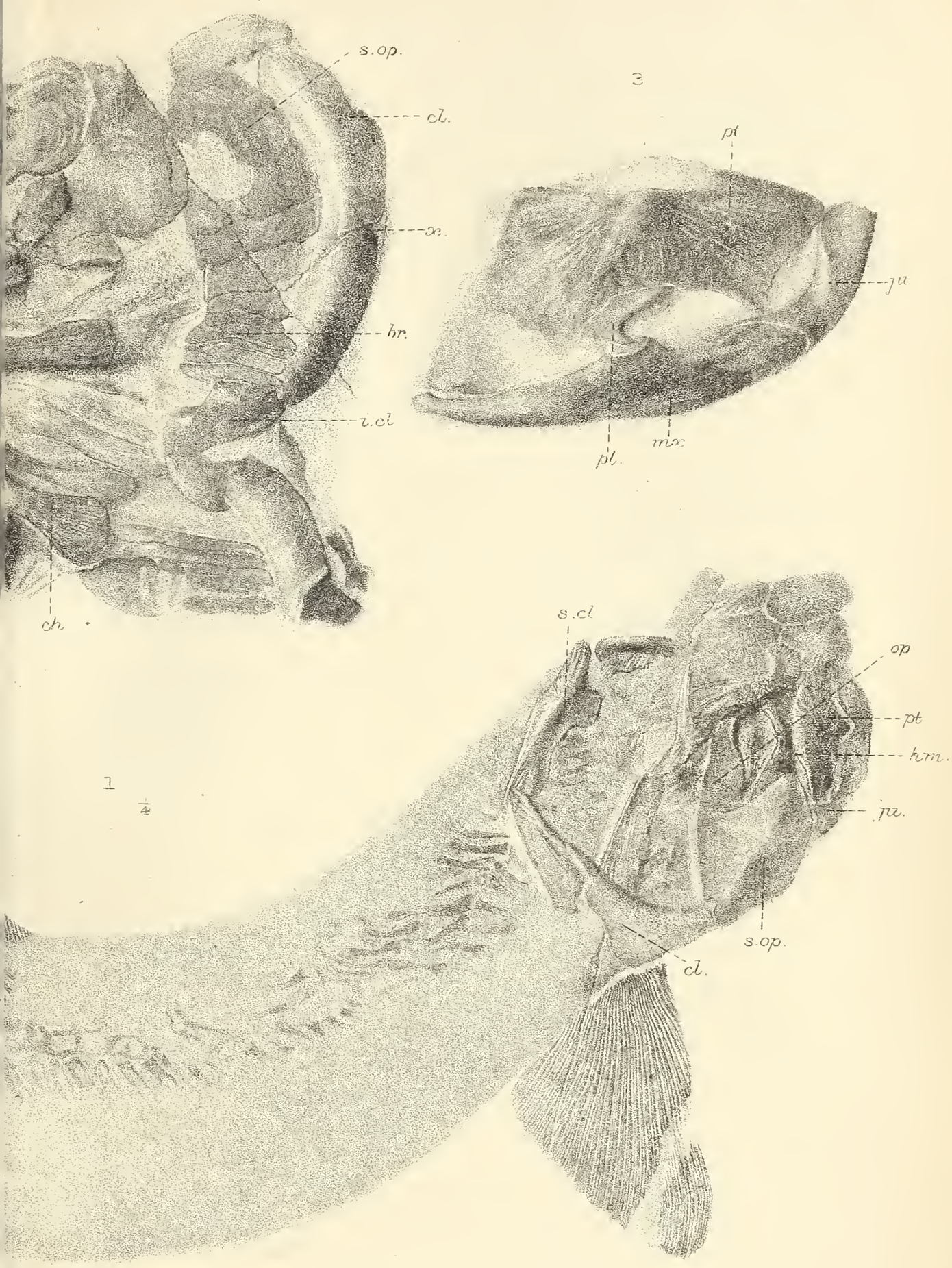
Chondrosteus



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acipenseroides.

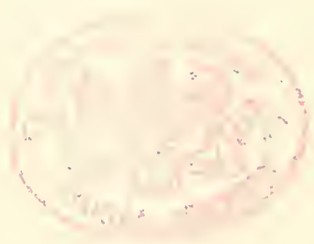


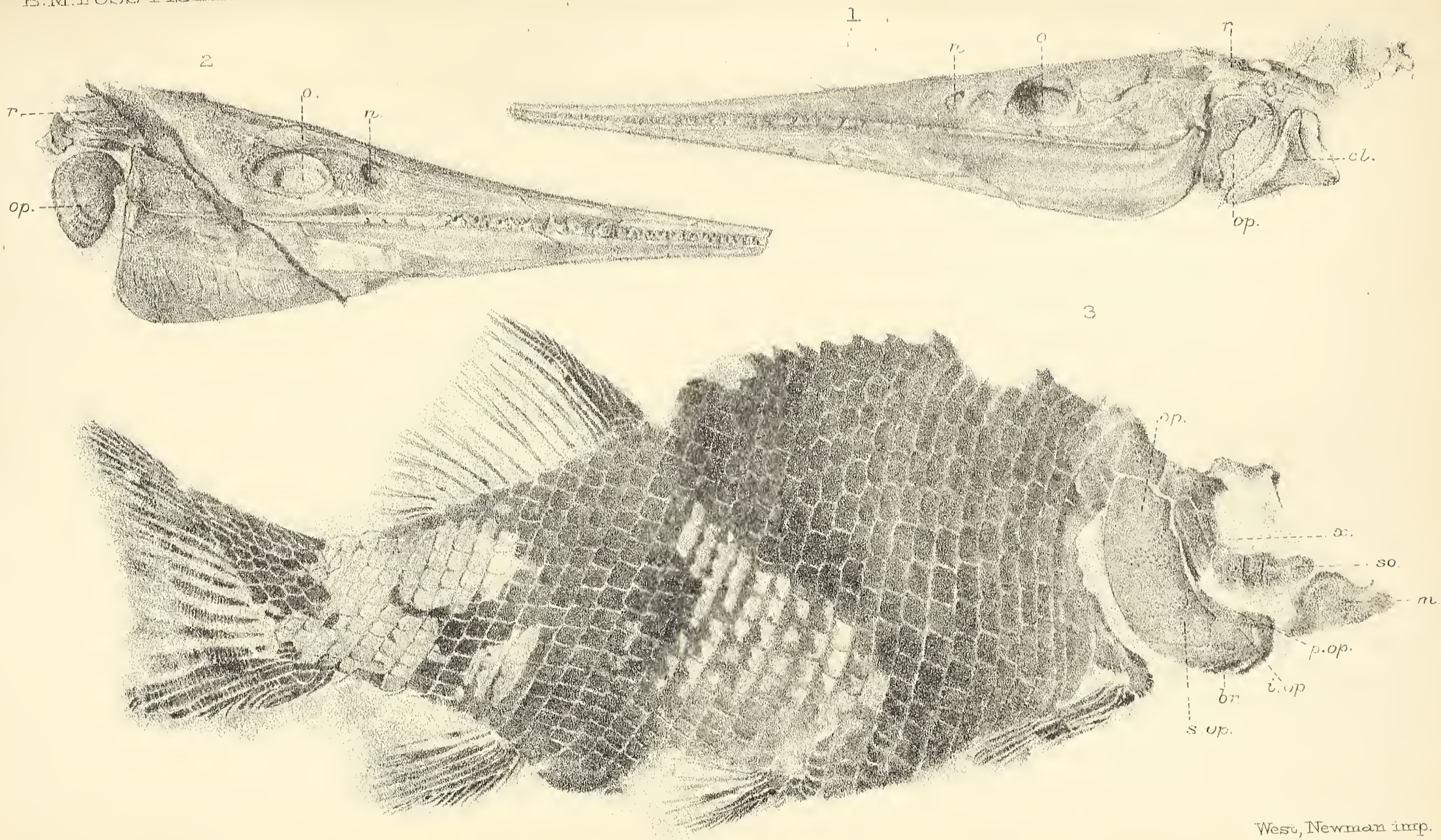
PLATE II.

Fig. Page

1. *Belonorhynchus acutus* (Agassiz); left lateral aspect of head.—Lower Lias; Lyme Regis. *cl.* Clavicle. *n.* Nasal opening. *o.* Orbit. *op.* Operculum. *r.* Extension of cranial roof. [P. 3791.] 15

2. *Belonorhynchus brevirostris*, sp. nov.; right lateral aspect of head.—Ibid. Lettering as above. [40726.] 17

3. *Semionotus bergeri*, Agassiz; lateral aspect.—Keuper; Coburg. *br.* Branchiostegal rays. *i.op.* Interoperculum. *m.* Portion of mandible. *op.* Operculum. *p.op.* Preoperculum. *s.op.* Suboperculum. *so.* Suborbitals. *x.* Cheek-plate. [P. 7399.] 56



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1. 2. Belonorhynchus. 3. Semionotus.

PLATE III.

Fig. Page

1. *Tetragonolepis semicinctus*, Bronn; left lateral aspect.—Upper Lias; Boll. [P. 3625 b.] 160

2. *Ophiopsis attenuata*, Wagner; right lateral aspect.—Lower Kimmeridgian; Kelheim. [P. 3609.] 167

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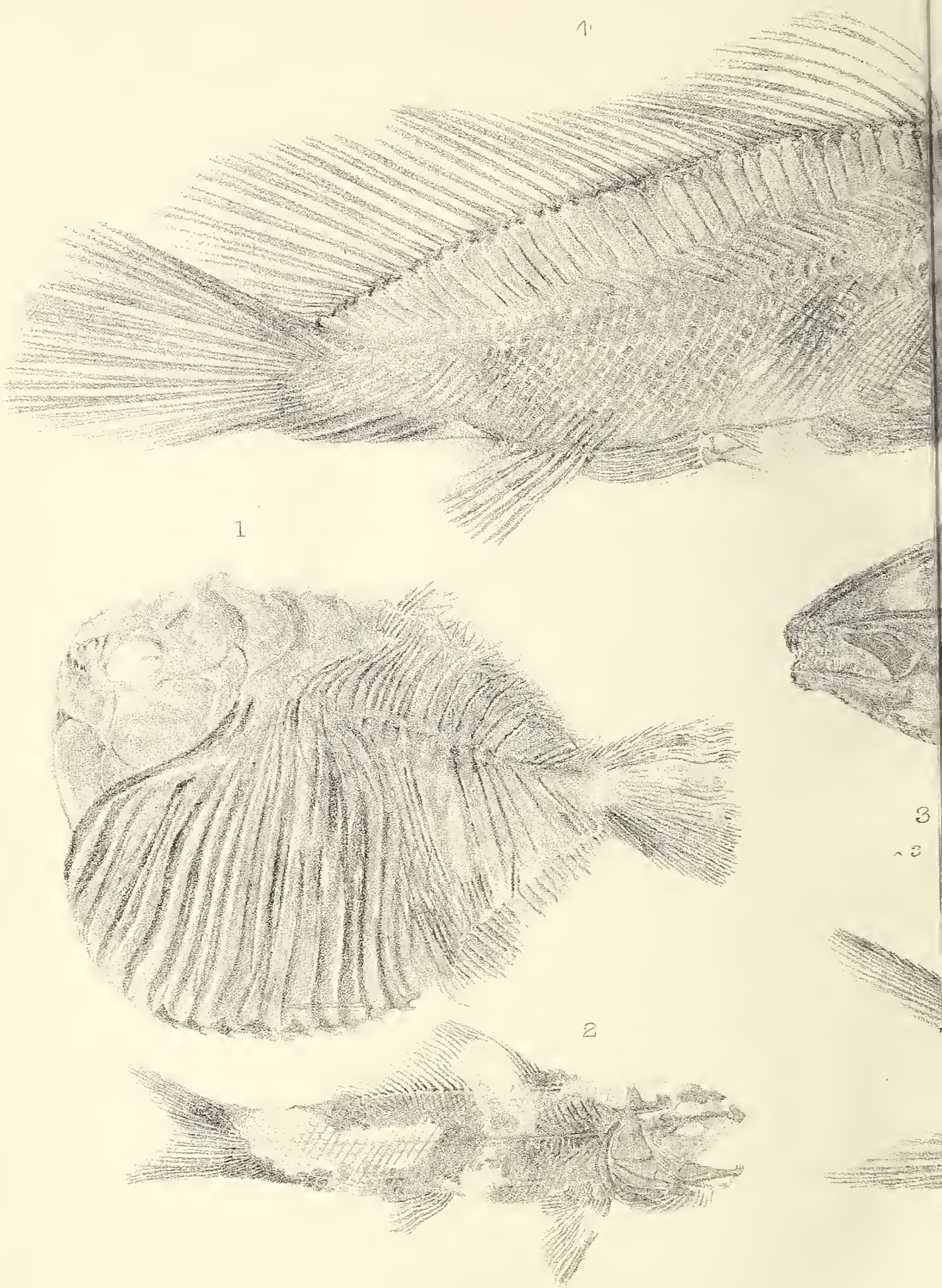

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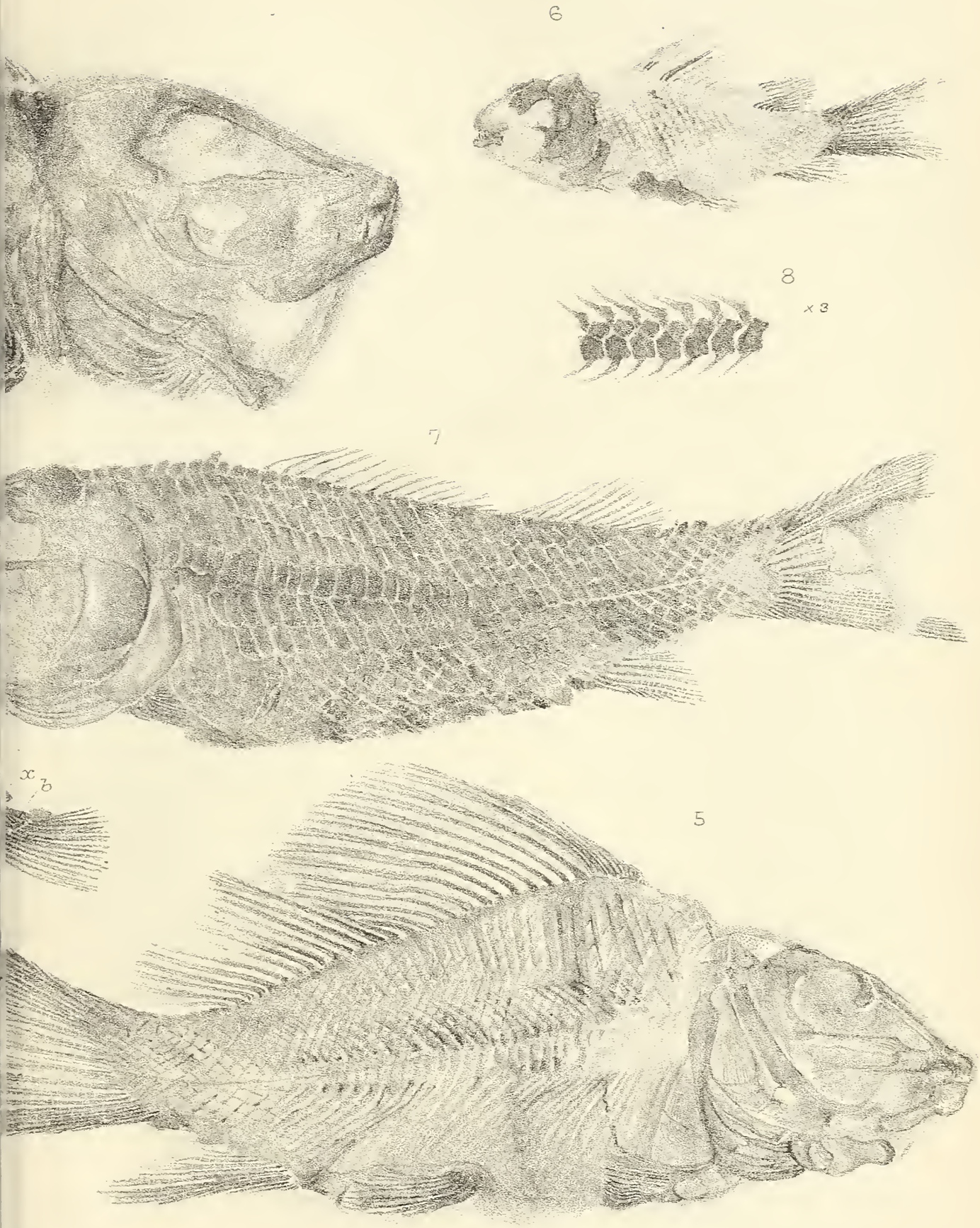
1.Tetragonolepis.



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1-8. Macrosemiidæ.

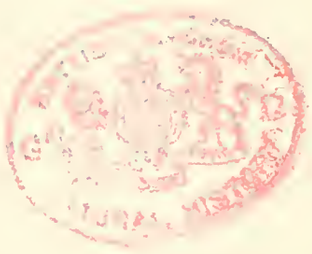

PLATE IV.

Fig. Page

1. *Eugnathus orthostomus*, Agassiz; head, pectoral fin, and scales, left lateral aspect.—Lower Lias; Lyme Regis. *ag.* Angular. *br.* Branchiostegal rays. *c.o.* Circumorbitals. *d.* Dentary. *fr.* Frontals. *i.op.* Interoperculum. *mx.* Maxilla. *op.* Operculum. *p.cl.* Postclavicular scales. *p.op.* Preoperculum. *p.t.* Post-temporal. *pa.* Parietal. *s.cl.* Supraclavicle. *s.mx.* Supramaxilla. *s.o.* Suborbitals (postorbitals). *s.op.* Suboperculum. *s.t.* Supratemporal. *sq.* Squamosal. [P. 3633 b.] 293

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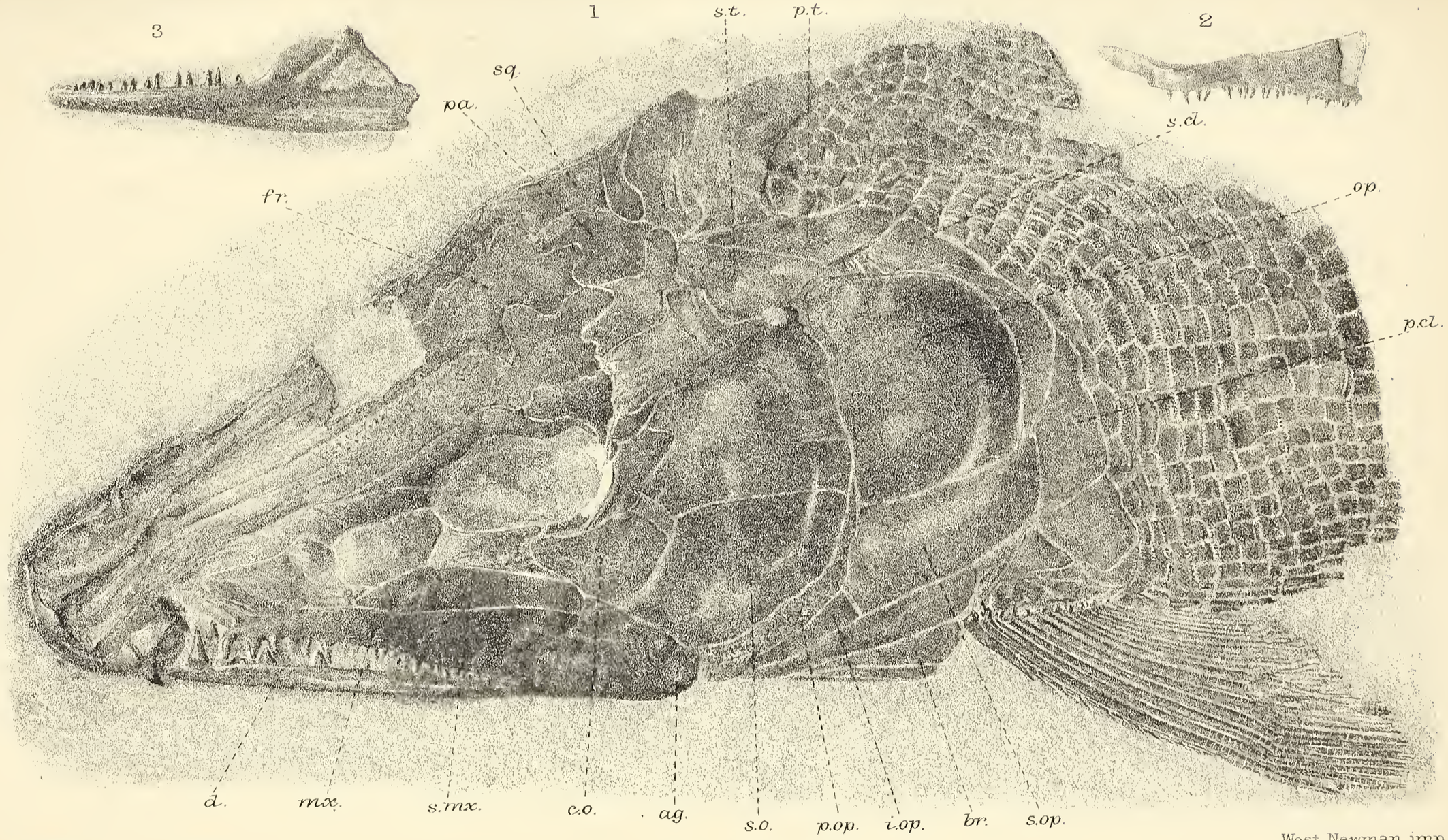
3. *Eugnathus minor*, Agassiz; left mandibular ramus, outer aspect.—Lower Lias; Lyme Regis. [P. 3634 e.] 297



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Eugnathus.

PLATE V.

Fig. Page

1. *Eugnathus orthostomus*, Agassiz (type specimen of so-called *E. scabriusculus*, Agassiz, MS.); lower portion of head, right lateral aspect.—Lower Lias; Lyme Regis. *ag.* Angular. *br.* Branchiostegal rays. *d.* Dentary. *g.* Gular plate. *i.op.* Interoperculum. *mx.* Maxilla. *p.op.* Preoperculum. *s.o.* Suborbital. *s.op.* Suboperculum. [P. 509.] 293

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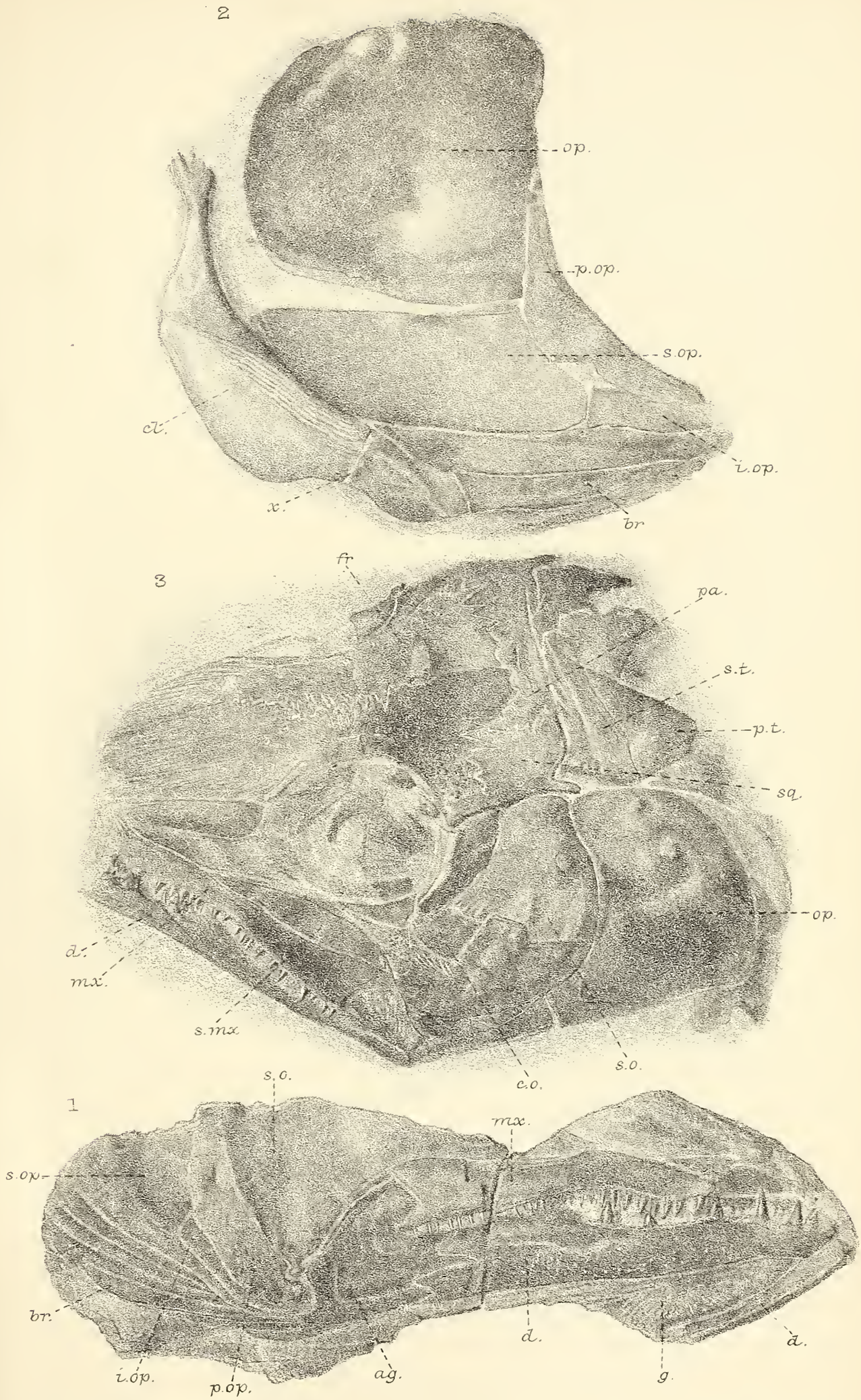

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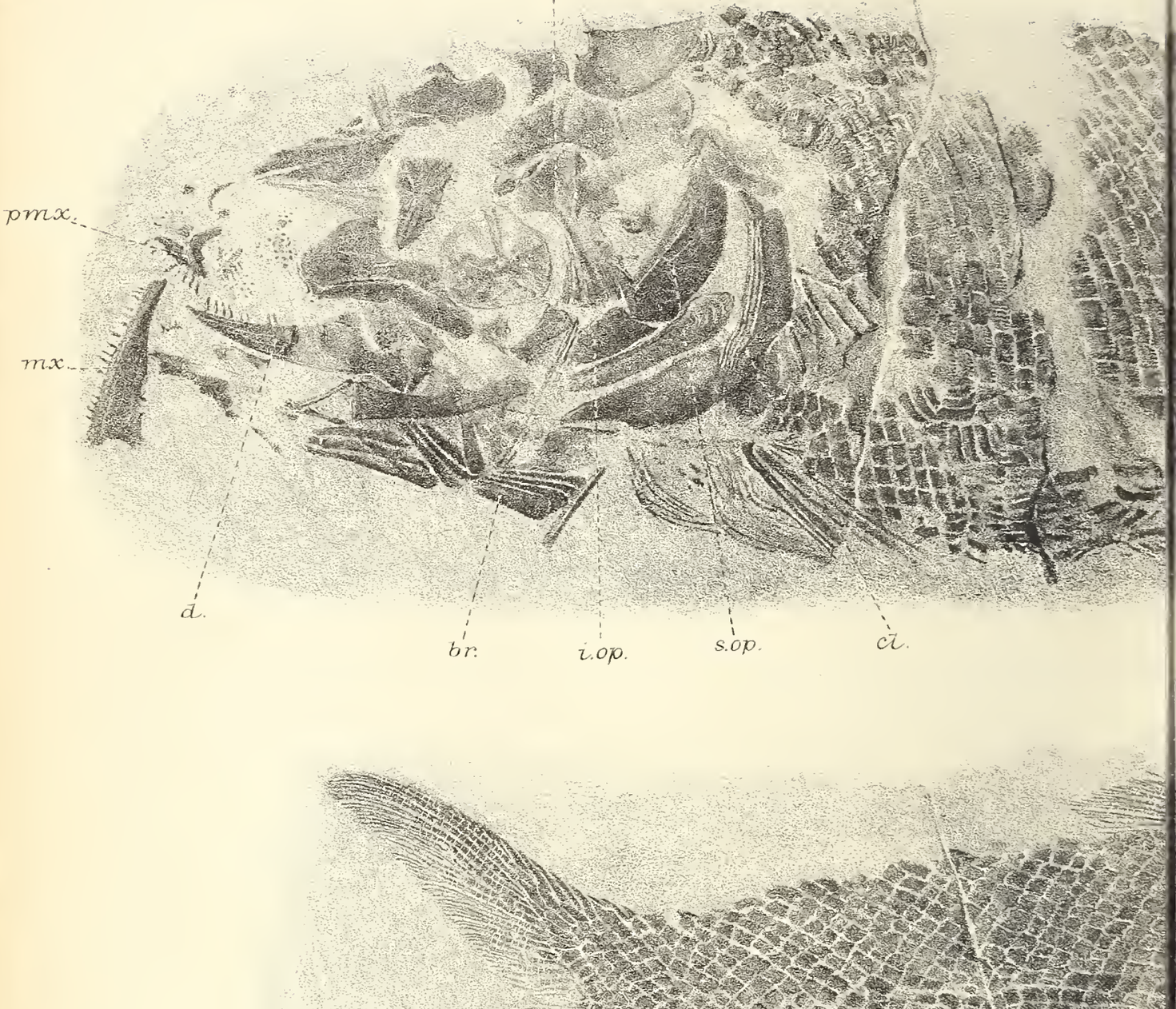
Eugnathus.



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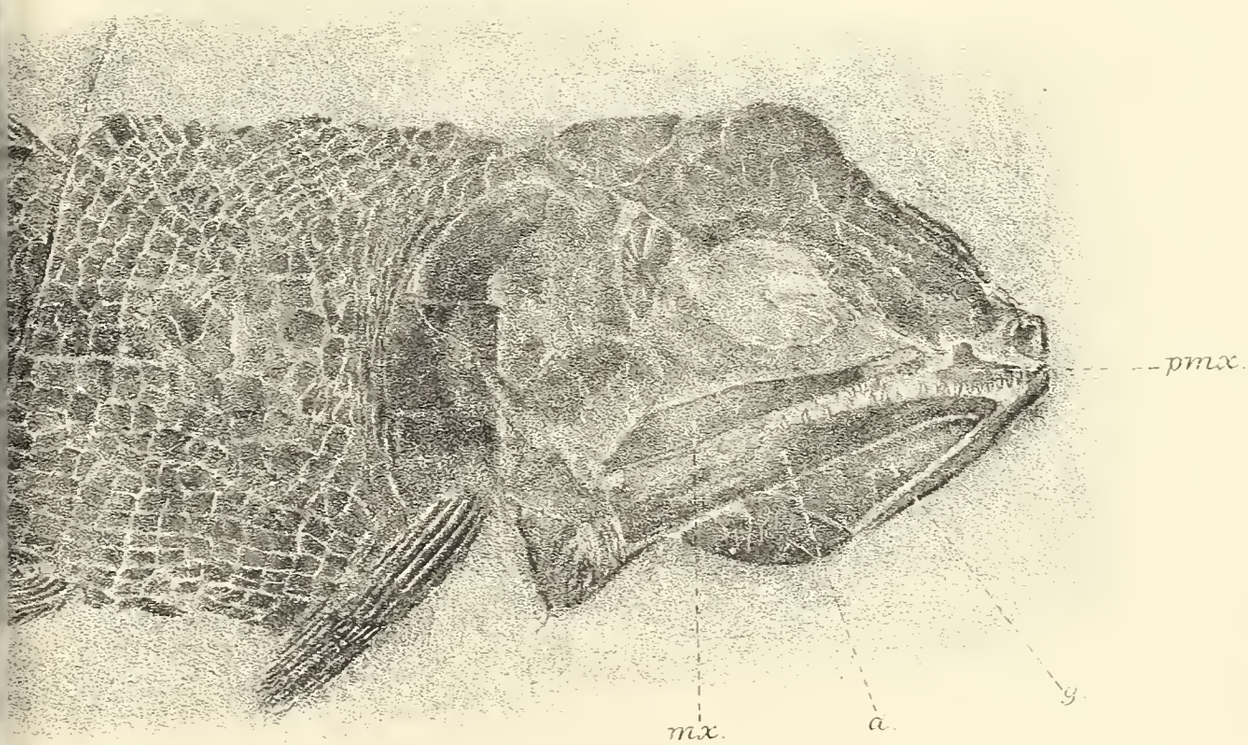

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athus.

PLATE VII.

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1. *Eugnathus hastingsiæ* (Agassiz); right lateral aspect.—Lower Lias; (?) Barrow-on-Soar. [P. 887 a.] 300

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5. Ditto; imperfect right dentary, outer aspect, one-half nat. size.—Ibid. *s.* Symphysial extremity. [P. 6034.] 347

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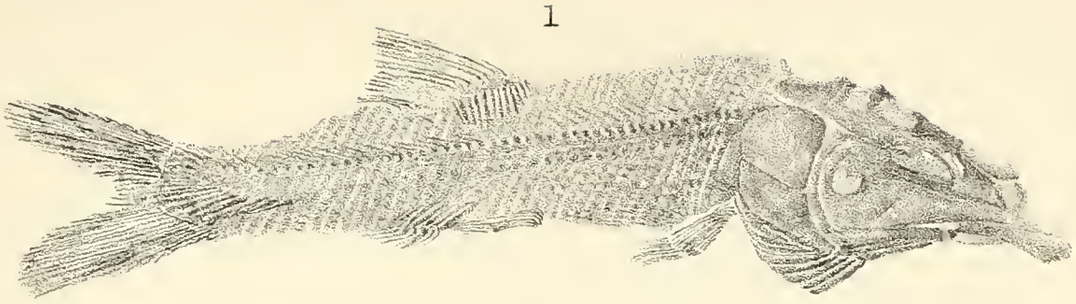

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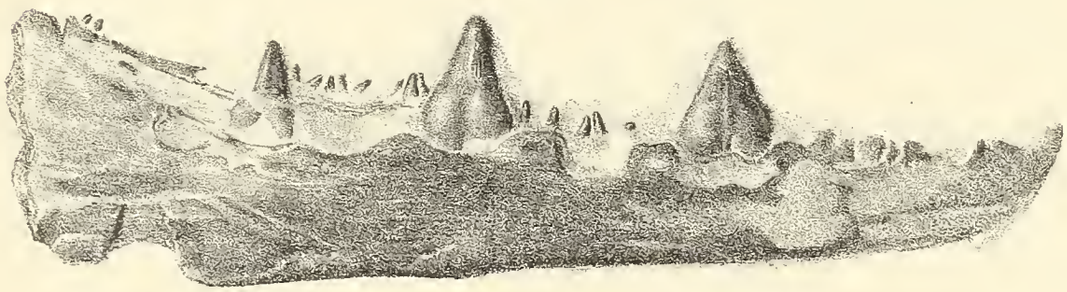

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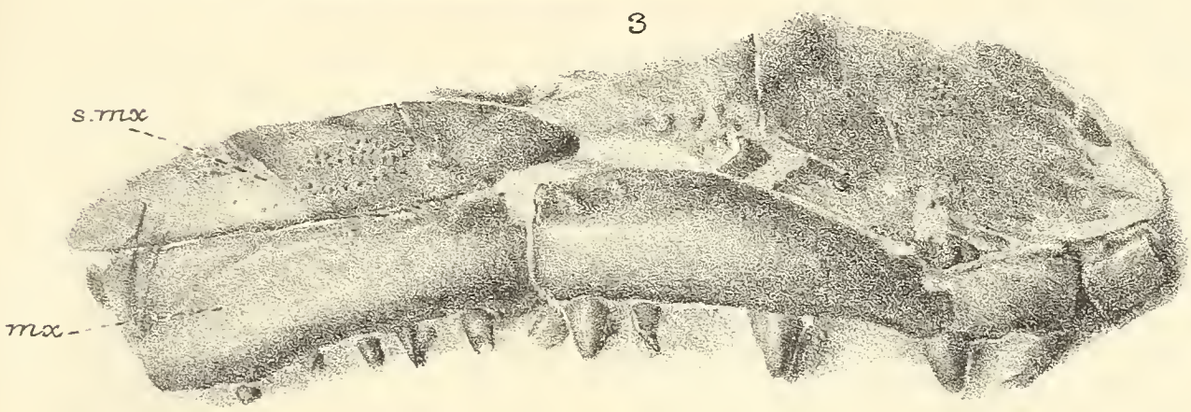

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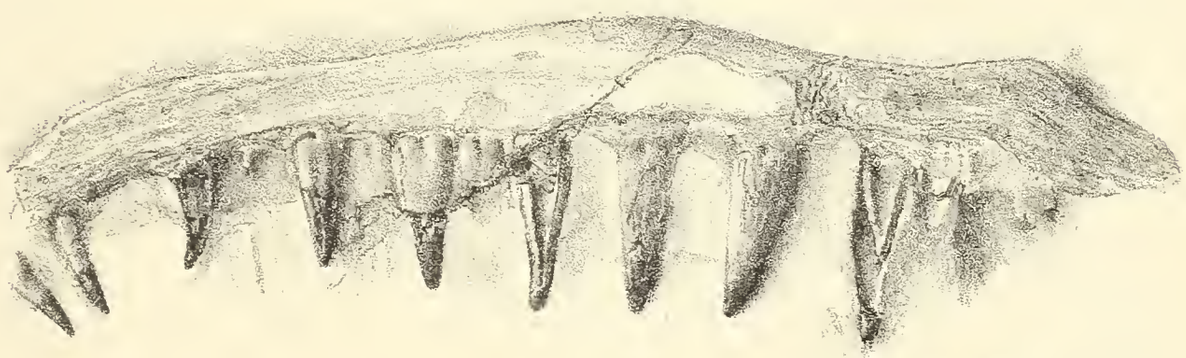

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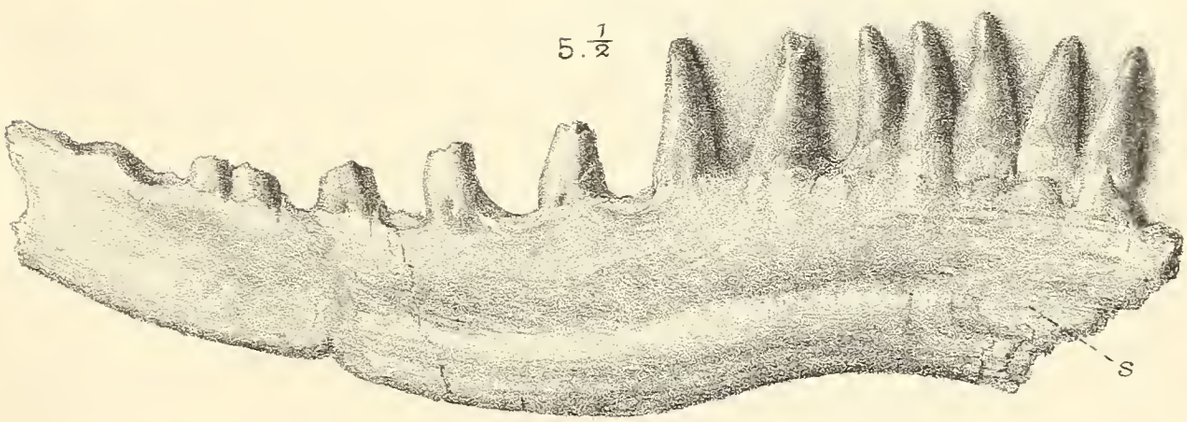

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Eugnathidæ.

PLATE VIII.

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1. *Lepidotus* (?) *pustulatus*, sp. nov.; series of scales of one individual (lettered *a* to *h*).—Grey Chalk; Folkestone. [**P. 21, P. 6201–a.**] 122

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4. *Neorhombolepis excelsus*, A. S. Woodward; right lateral aspect of type specimen.—Lower Chalk; Upper Halling.
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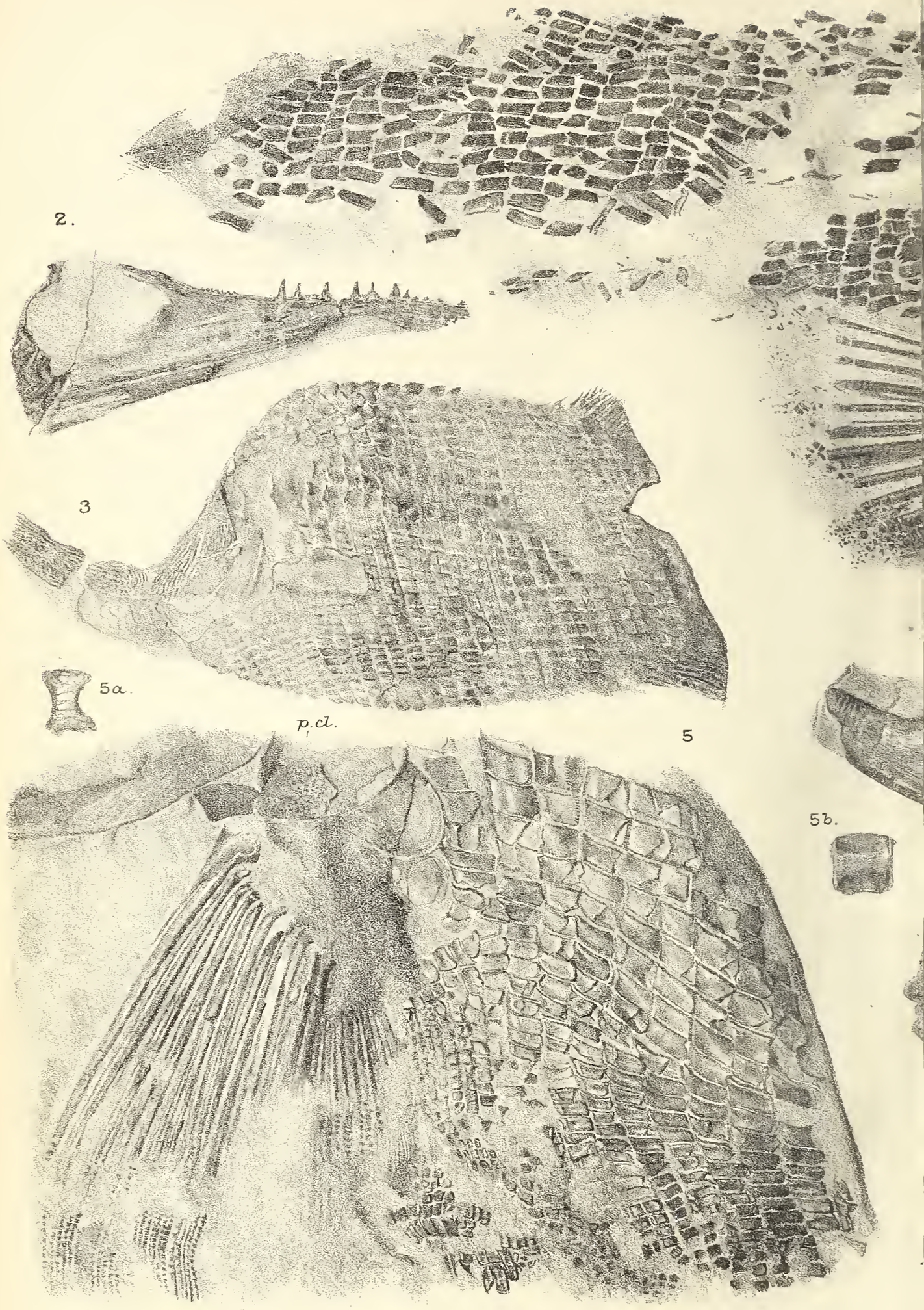
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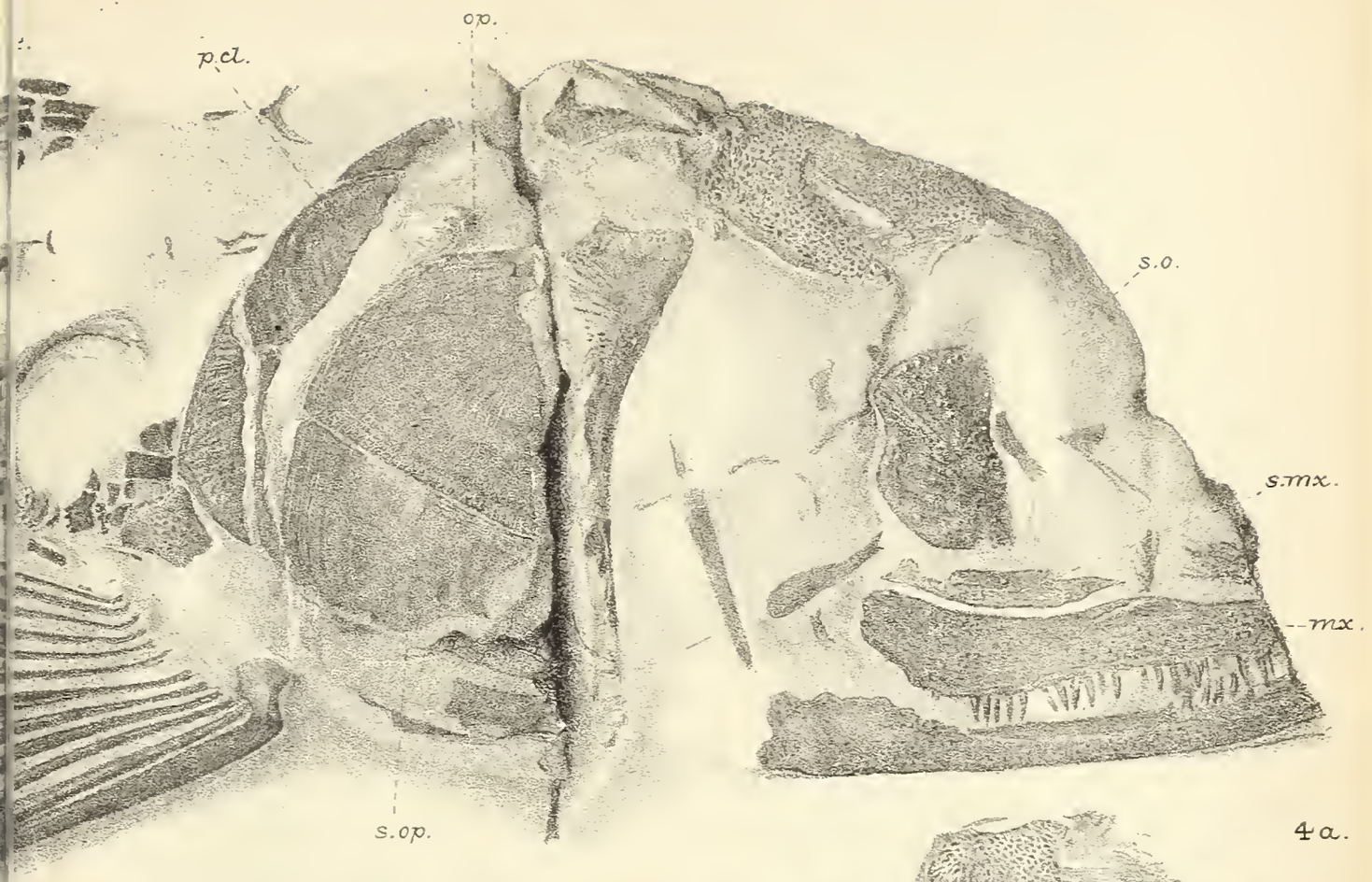

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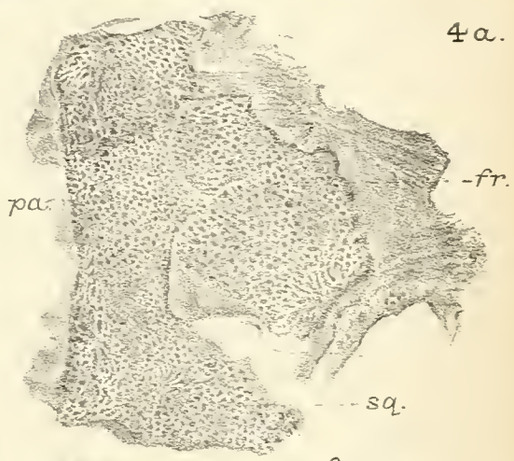

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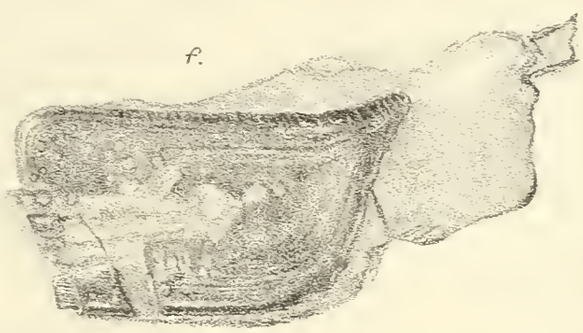

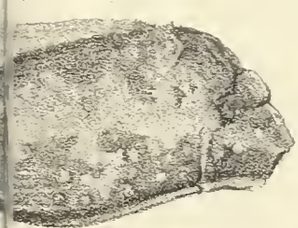

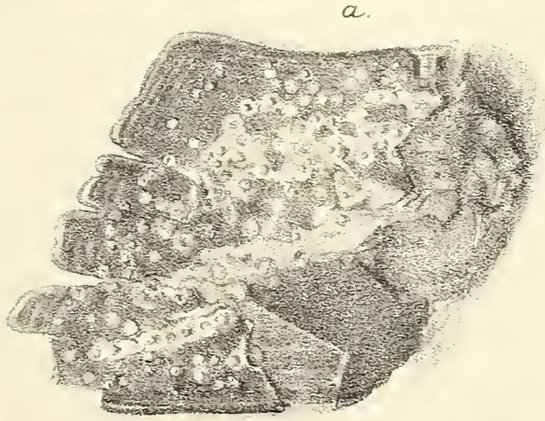

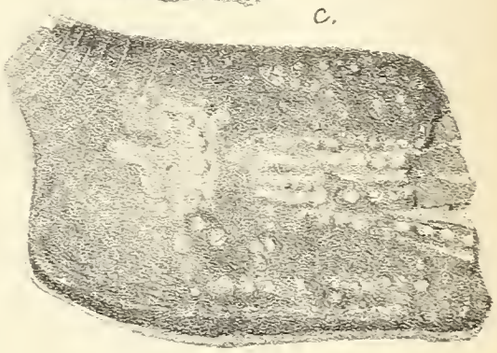

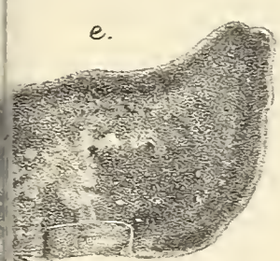

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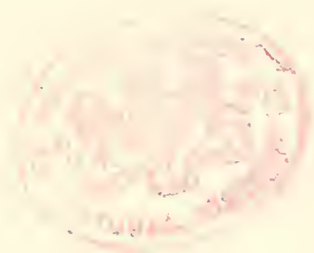

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Caturus.

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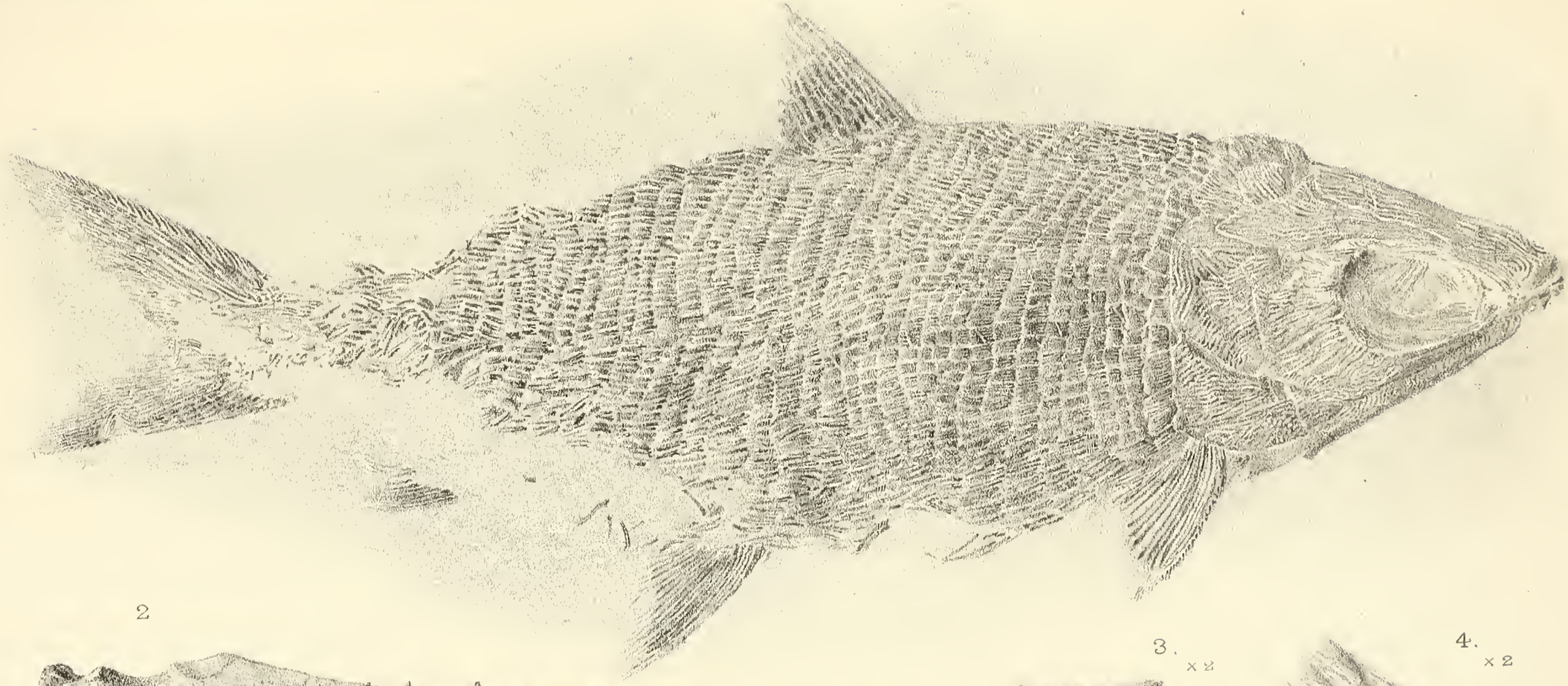

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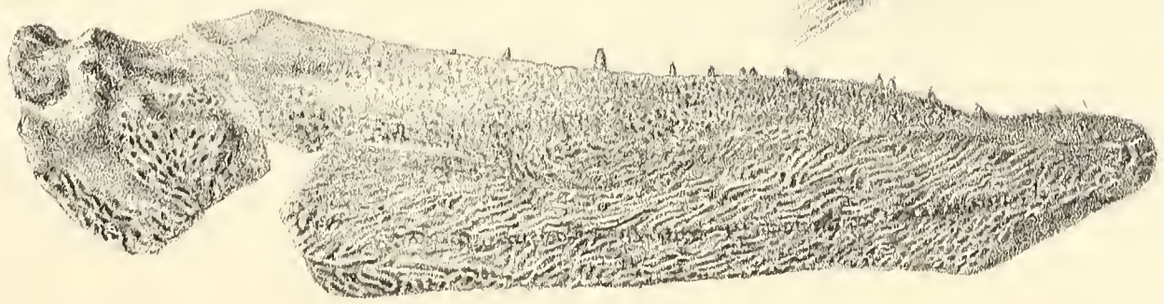

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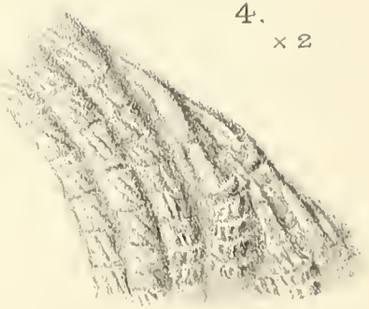

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Ptycholepis

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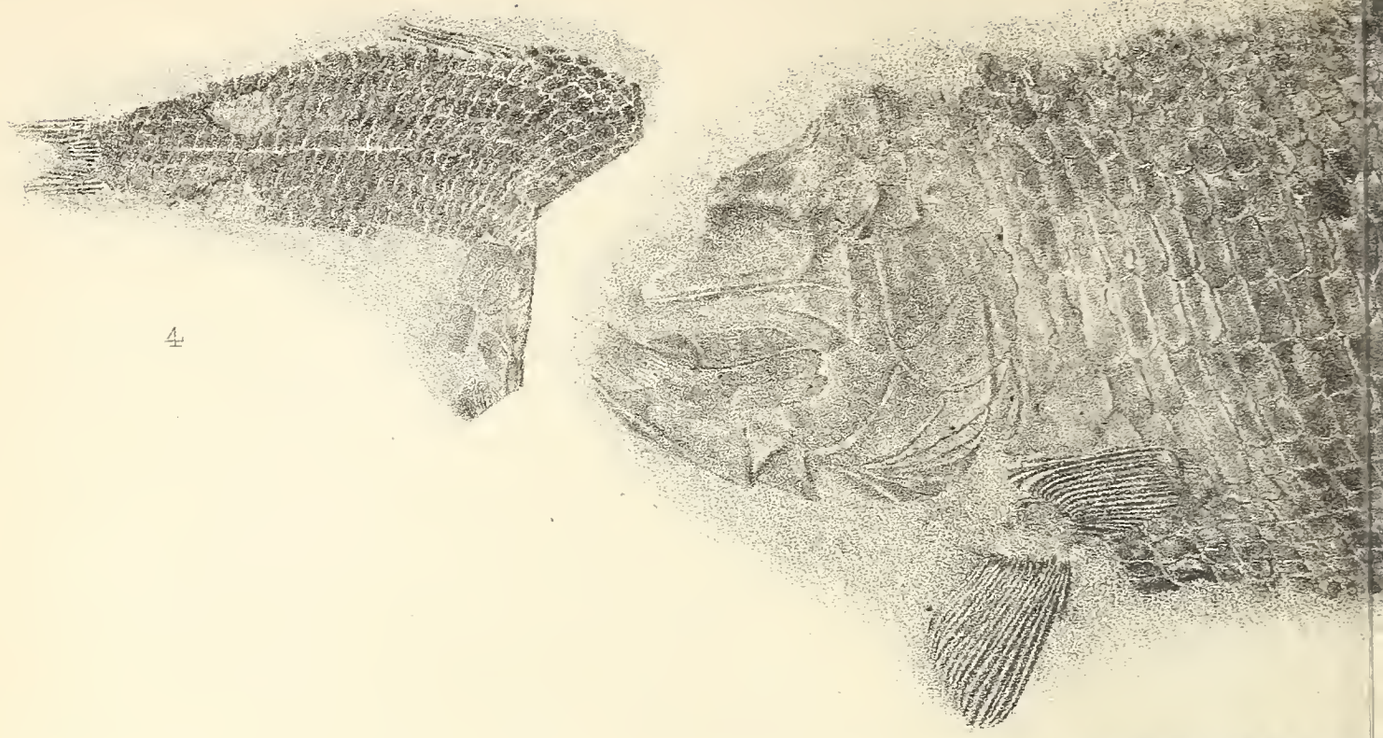

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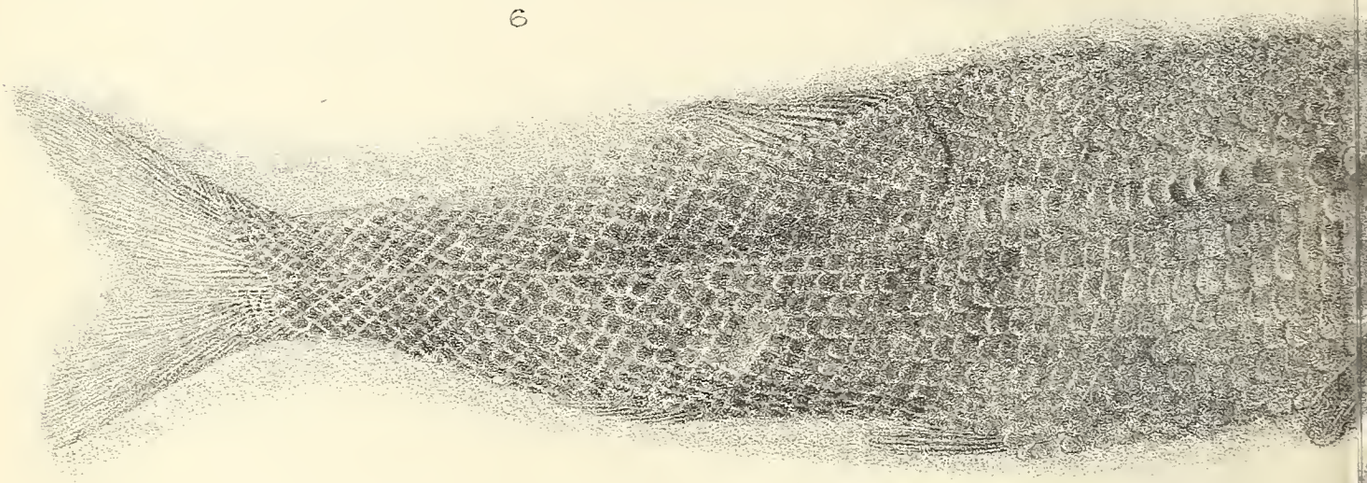

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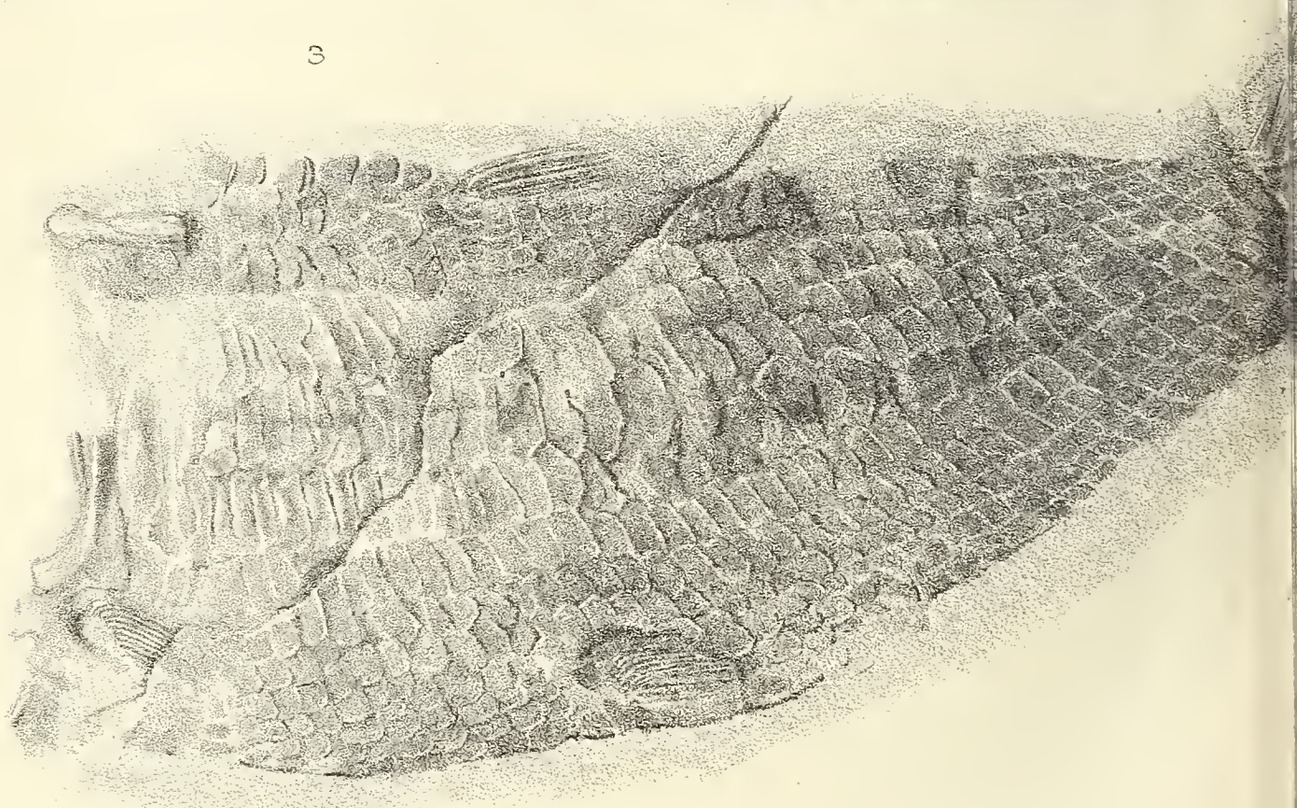

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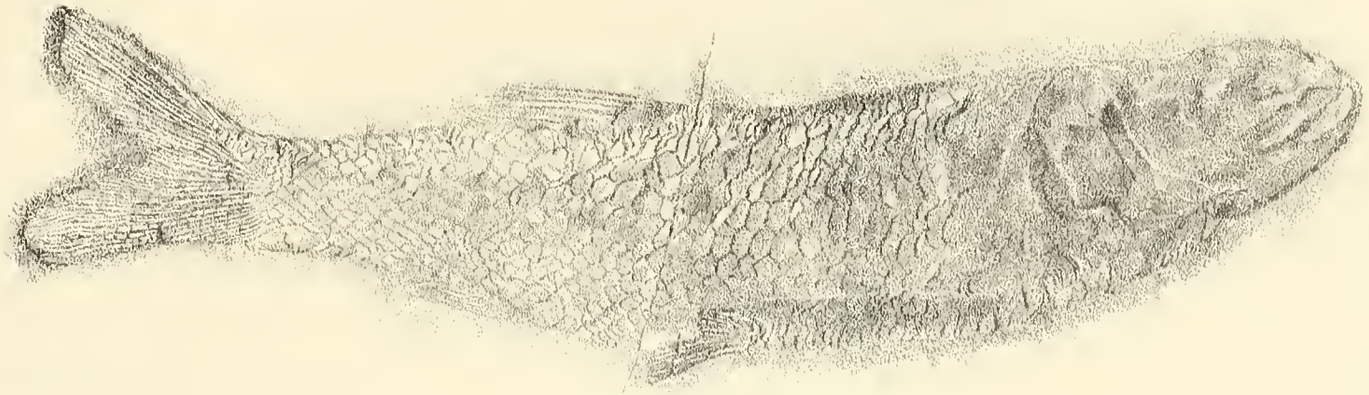

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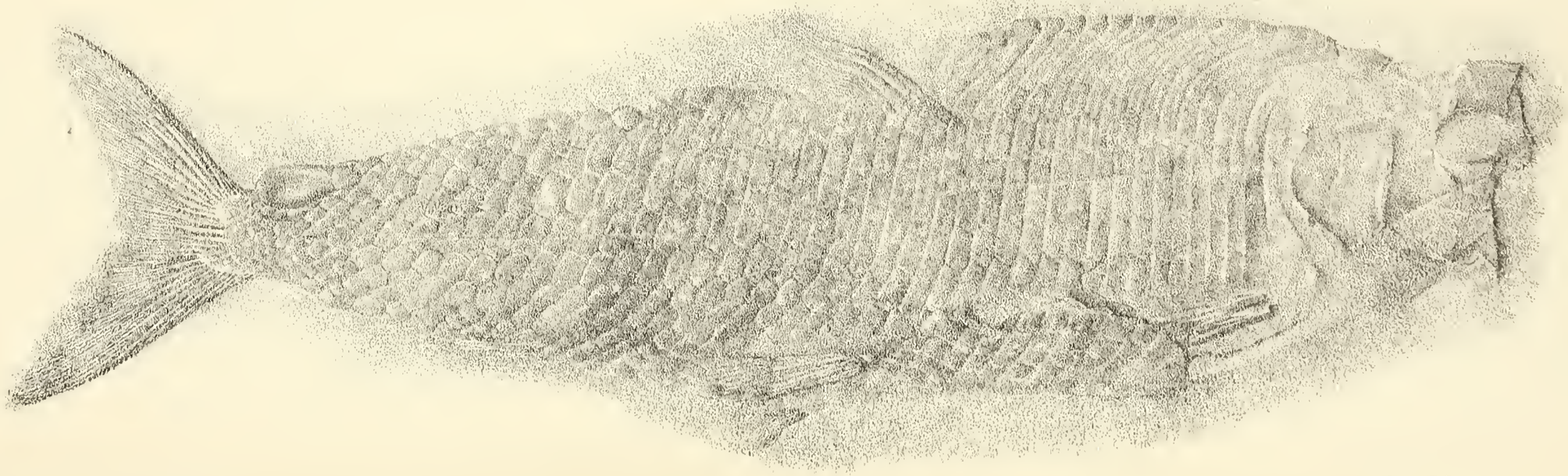

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Pholidophorus.

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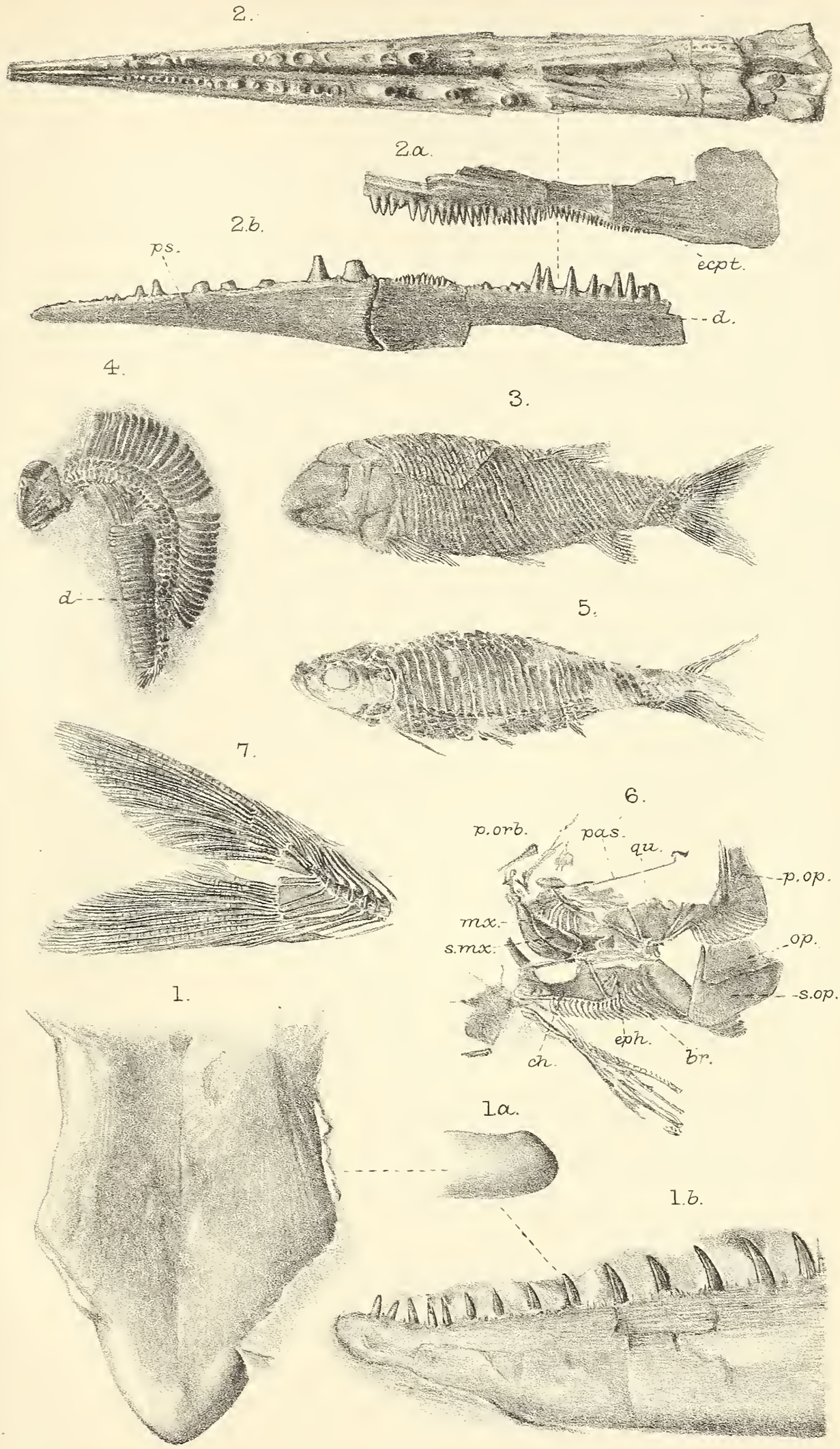

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1. Hypsocormus. 2. Belonostomus.
3–5. Pholidophoridæ. 6, 7. Leptolepis.

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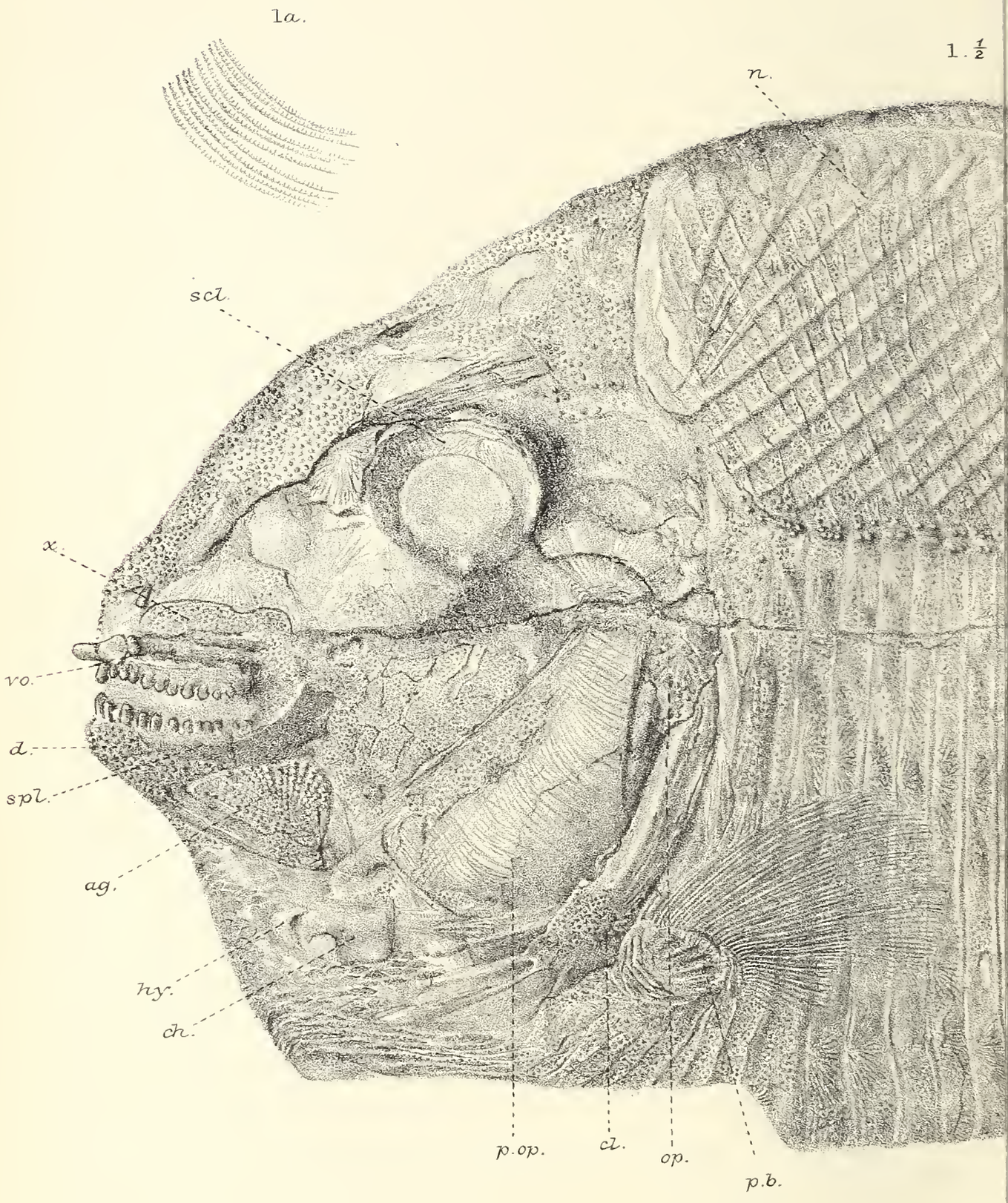
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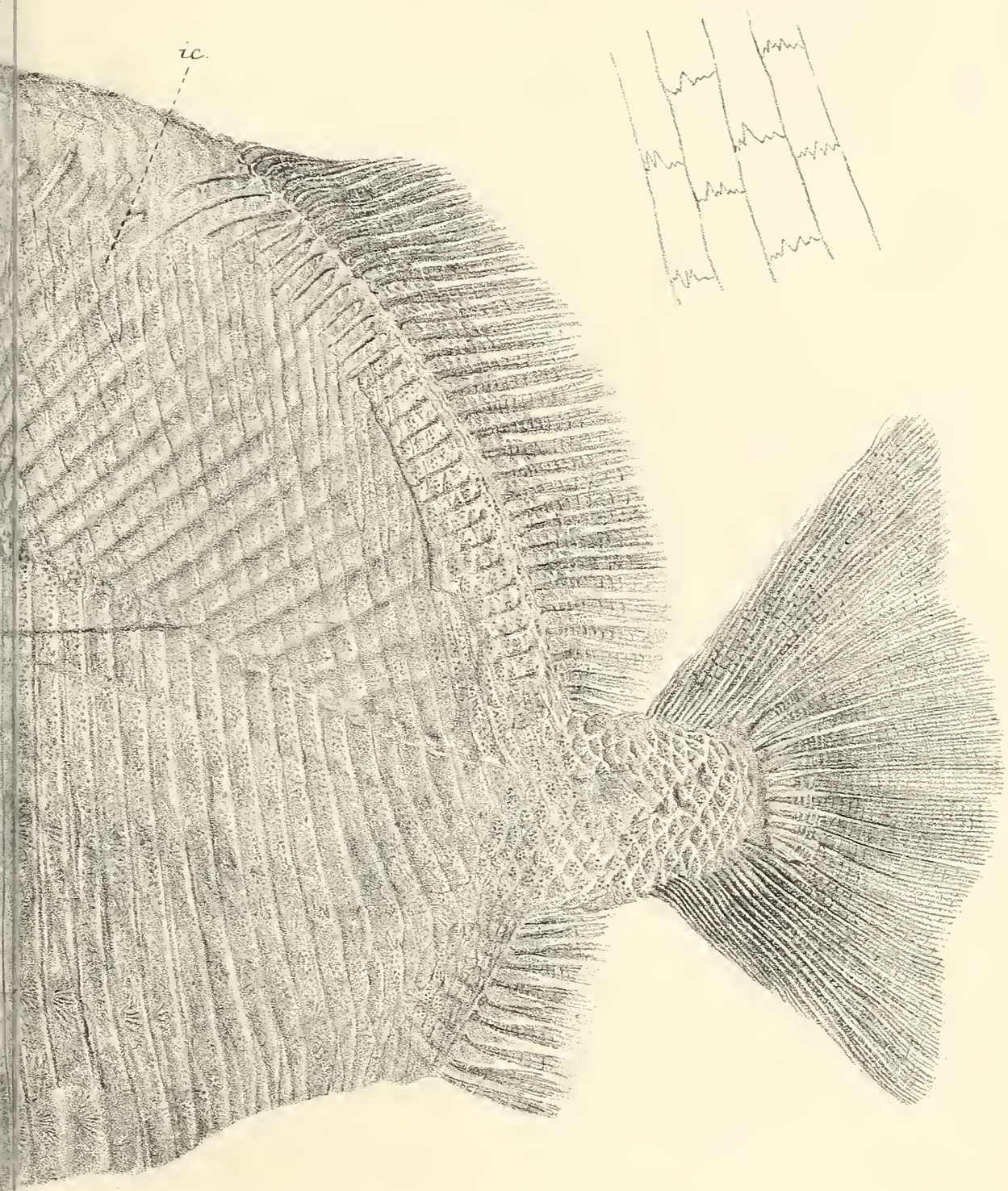

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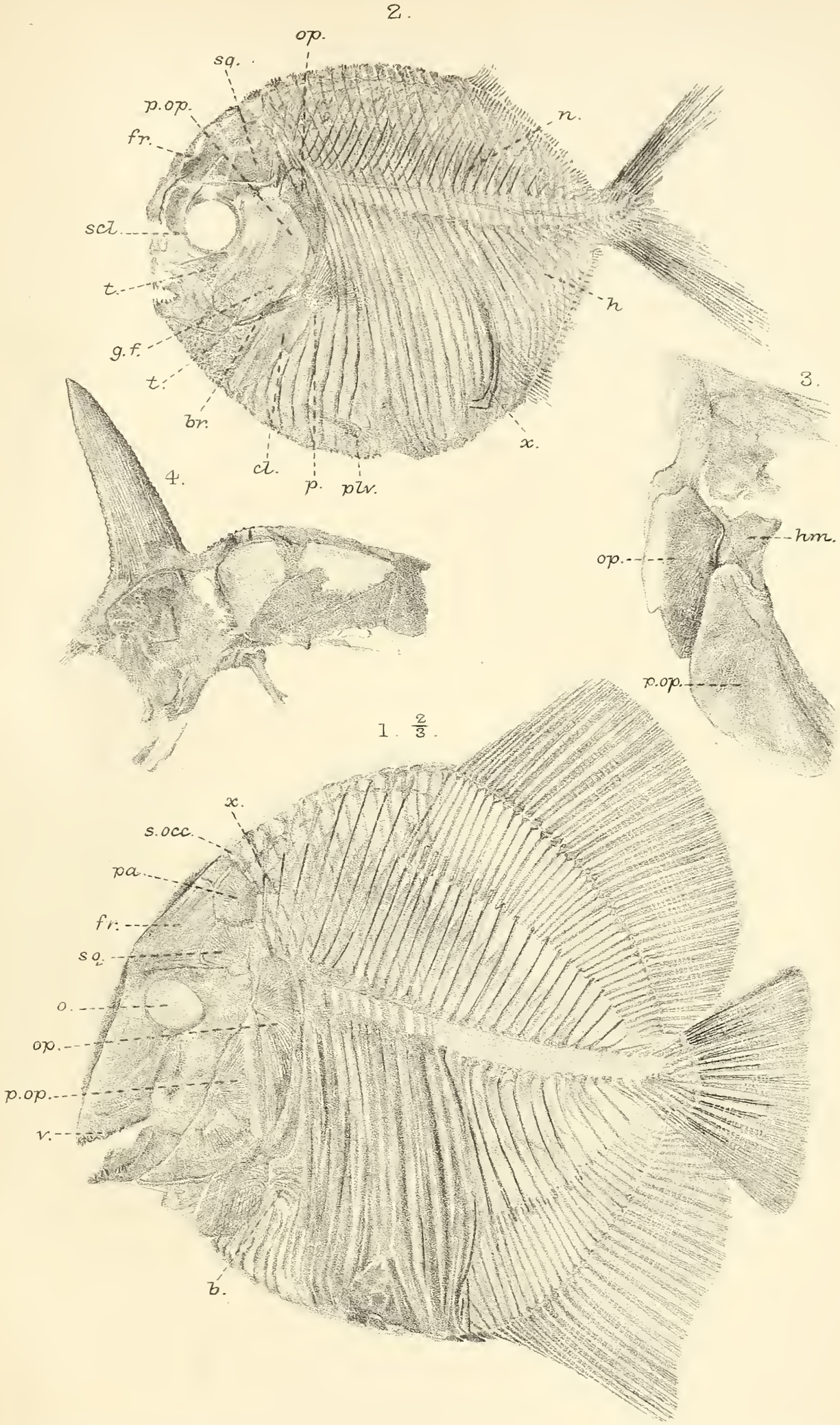

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Pycnodontidæ.

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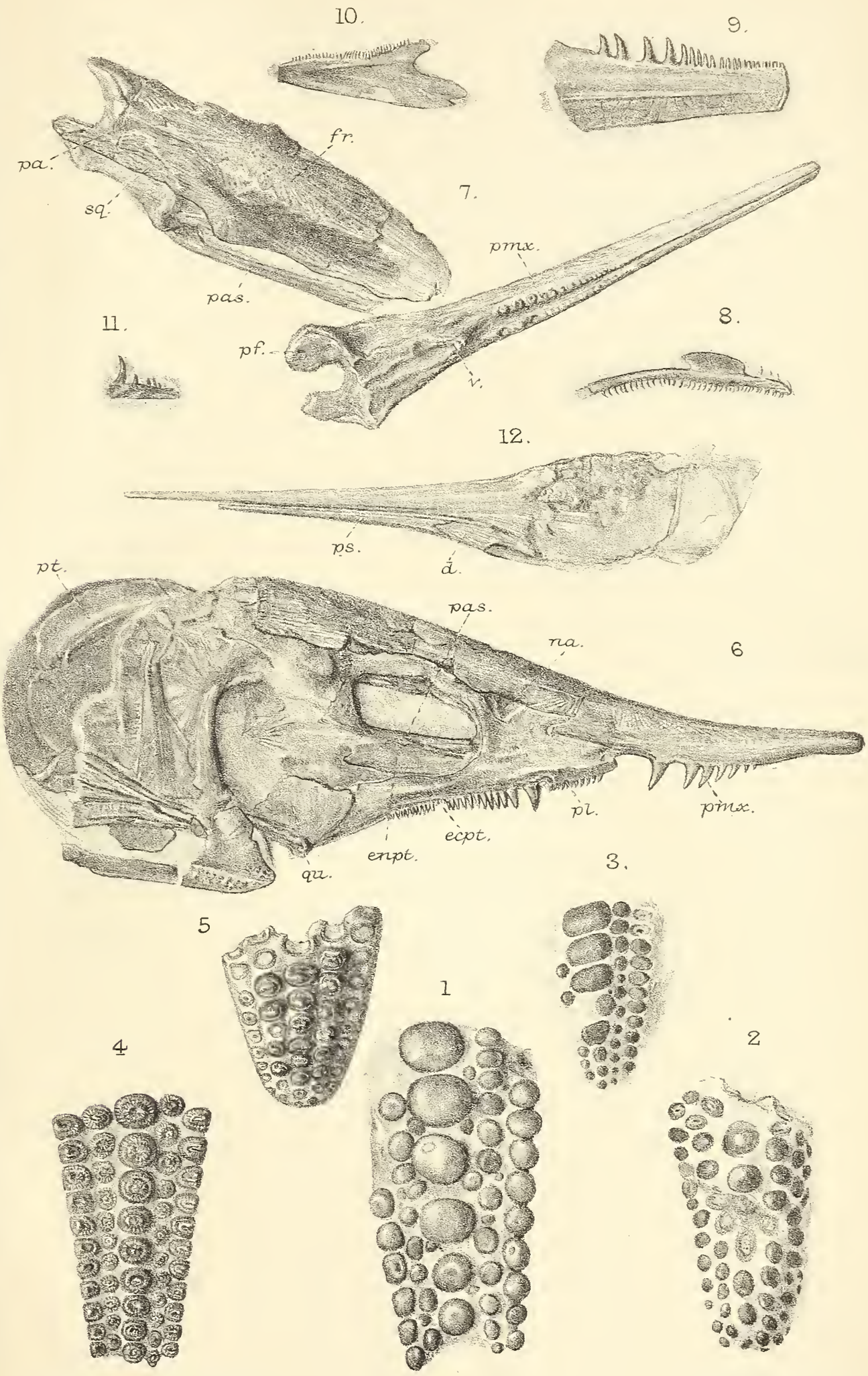

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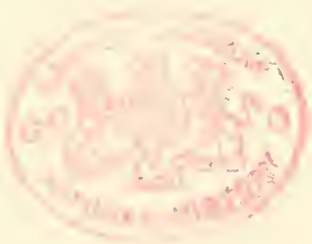
1–5. Pycnodontidæ. 6–12. Aspidorhynchidæ.



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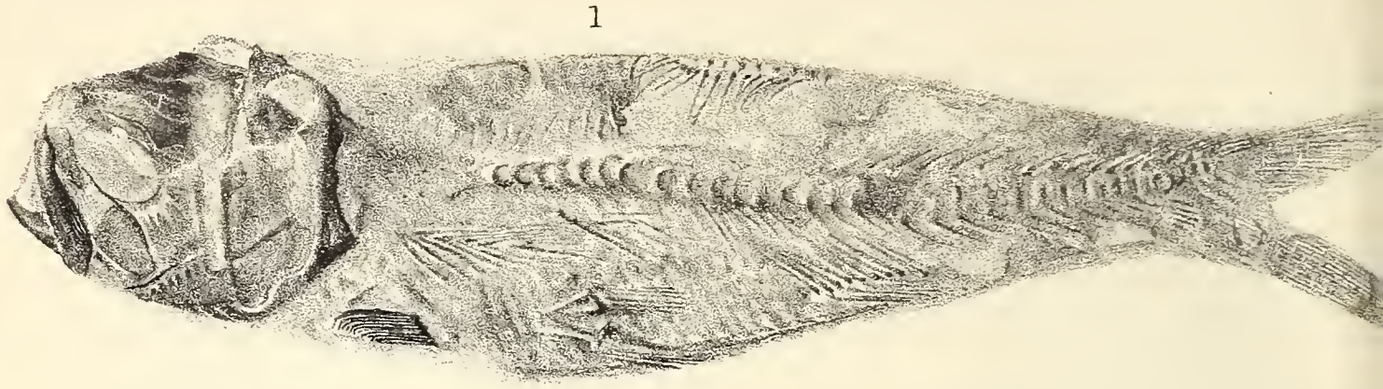

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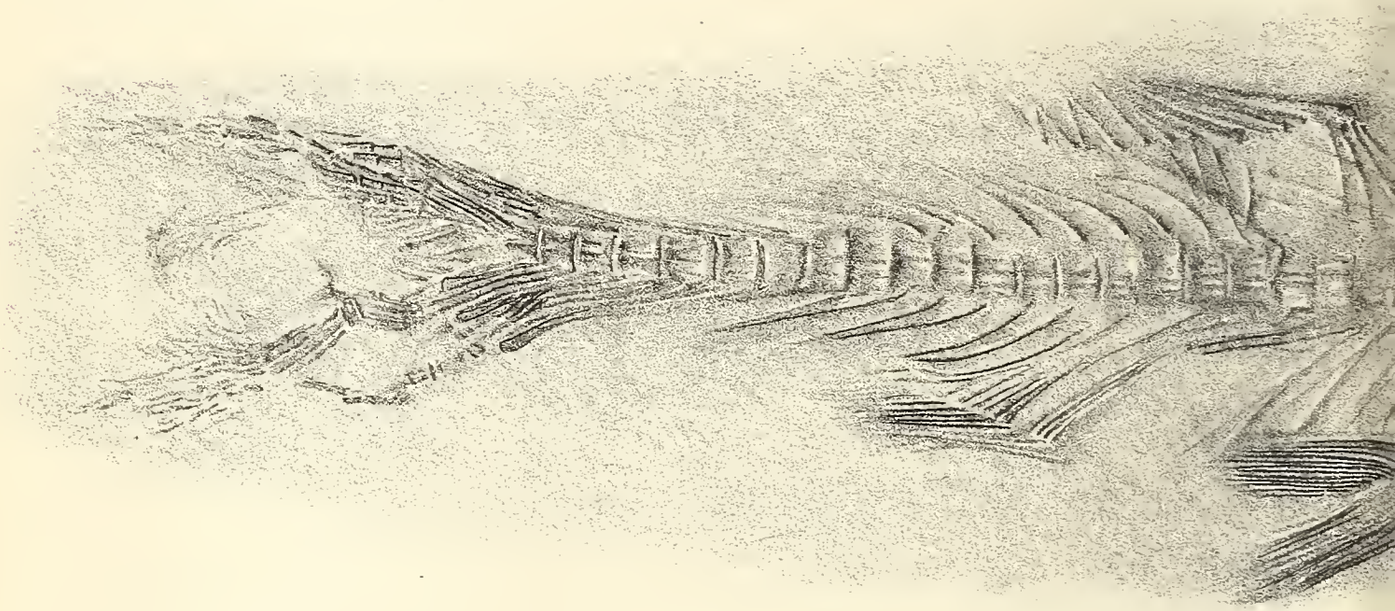

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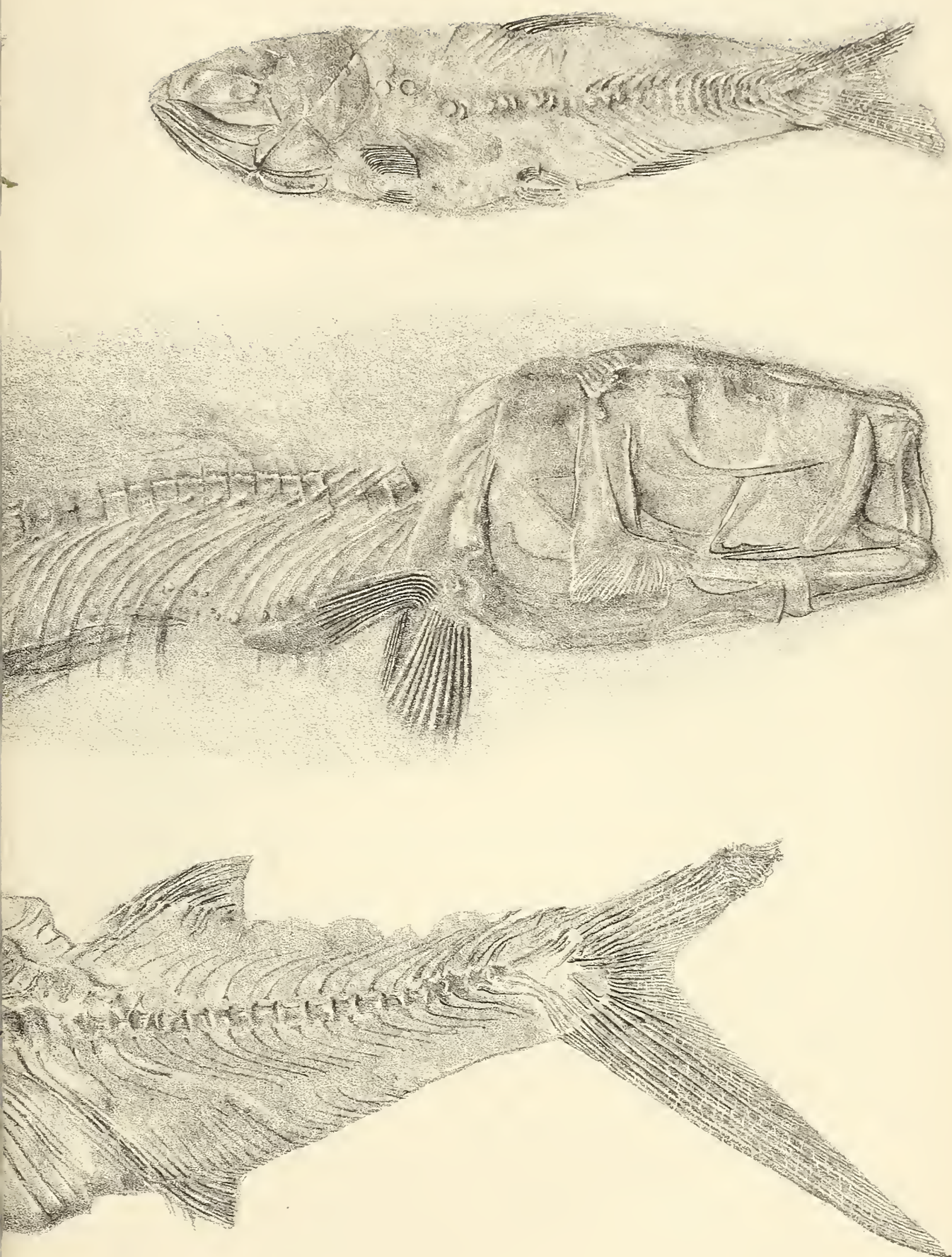

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3. Leptolepis.

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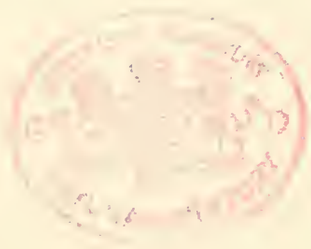

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